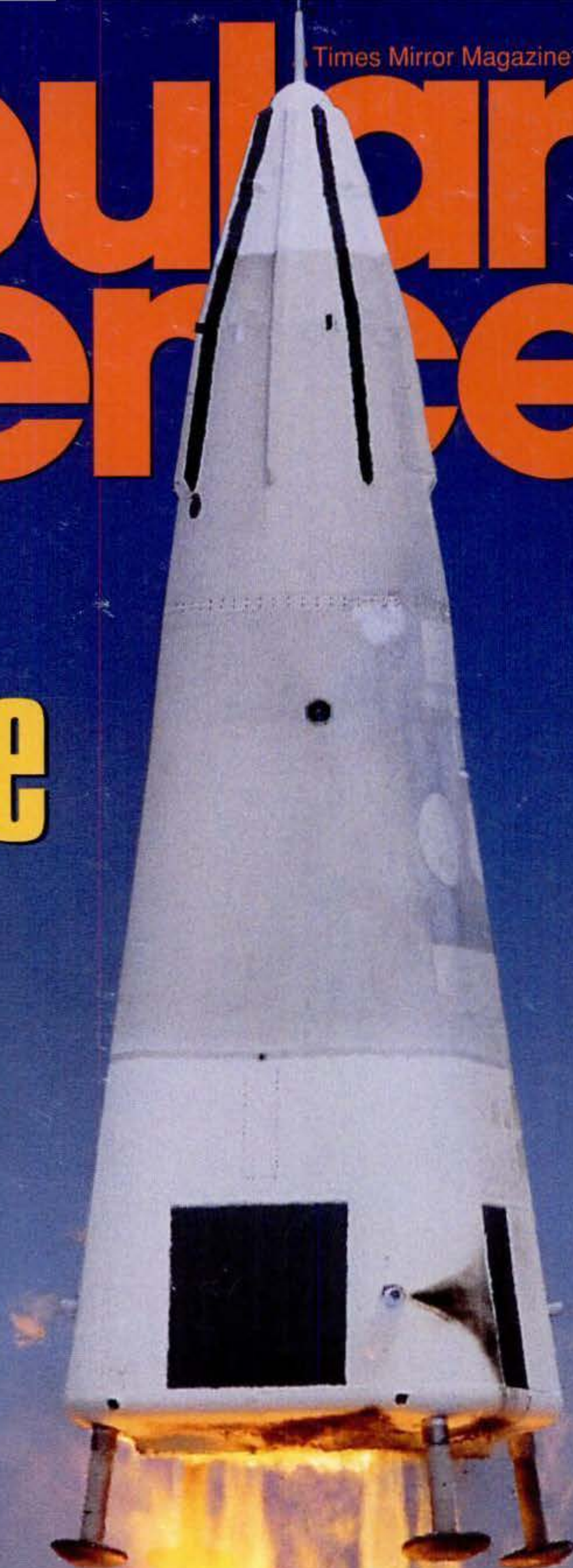


Popular Science

Times Mirror Magazine

Reusable Rocket Ships

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FEBRUARY 1994
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DODGE DAKOTA	Available 5.2L V-8 MPI	220 @ 4400 rpm/ 295 @ 3200 rpm	Max. 2600 lbs	Max. 7100 lbs	Std. driver's airbag Avail. 4-wheel ABS	3/36 Bumper-to-Bumper or 7/70 Powertrain
Dakota Superiorities	A V-8 compact pickups don't offer	More available power	More available payload	More available towing	More safety features	Dodge provides the only choice of warranties, our Owner's Choice Protection Plan, offering longest powertrain protection.†
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FORD RANGER	Available 4.0L V-6 MPI	160 @ 4000 rpm/ 225 @ 2500 rpm	Max. 1650 lbs	Max. 6000 lbs	No driver's airbag No 4-wheel ABS	3/36 Bumper-to-Bumper
CHEVY S-10	Available 4.3L V-6 CPI	195 @ 4500 rpm/ 260 @ 3600 rpm	Max. 1901 lbs	Max. 6000 lbs	No driver's airbag Avail. 4-wheel ABS	3/36 Bumper-to-Bumper



Data based on information available at time of printing, including some '93 competitive data. See dealer for latest information. †See Dodge's limited warranties, restrictions & details at dealer. Normal maintenance, adjustments and wear items excluded. Warranty provisions vary by manufacturer. **TREAD LIGHTLY!** Always wear your seat belt.

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Popular Science

THE WHAT'S NEW MAGAZINE

FEBRUARY 1994

A TIMES MIRROR
MAGAZINE

FOUNDED IN 1872

VOLUME 244

NUMBER 2

COVER BY
ROGER RESSMEYER/
STEVE KARP

FEATURES

REUSABLE ROCKET SHIPS

49

Paging Buck Rogers: A new generation of spacecraft is poised to leapfrog past the space shuttle and today's throwaway rockets. This could be the harbinger of a first in space-flight—a truly affordable ride to orbit.

INSANELY GREAT

56

Ten years ago, Apple's vision of an elegant and efficient yet low-cost computer reached its first fruition with the Macintosh. The brainchild of a colorful band of true believers, the Mac has become a machine that has changed how people work and even think.

HEAVY HAULERS

60

Today, a full-size pickup needs to be more than merely a dry place to sit while you do serious work. These vehicles now add carlike styling and comfort to old-fashioned muscle and guts, and feature 0-60 mph acceleration that would embarrass many a sedan. We rate three turbo-diesel workhorses: the Chevrolet 2500 Silverado, the Dodge Ram 2500 Laramie SLT, and the Ford F-250 XLT.

SCIENCE GETS THE CO₂ OUT

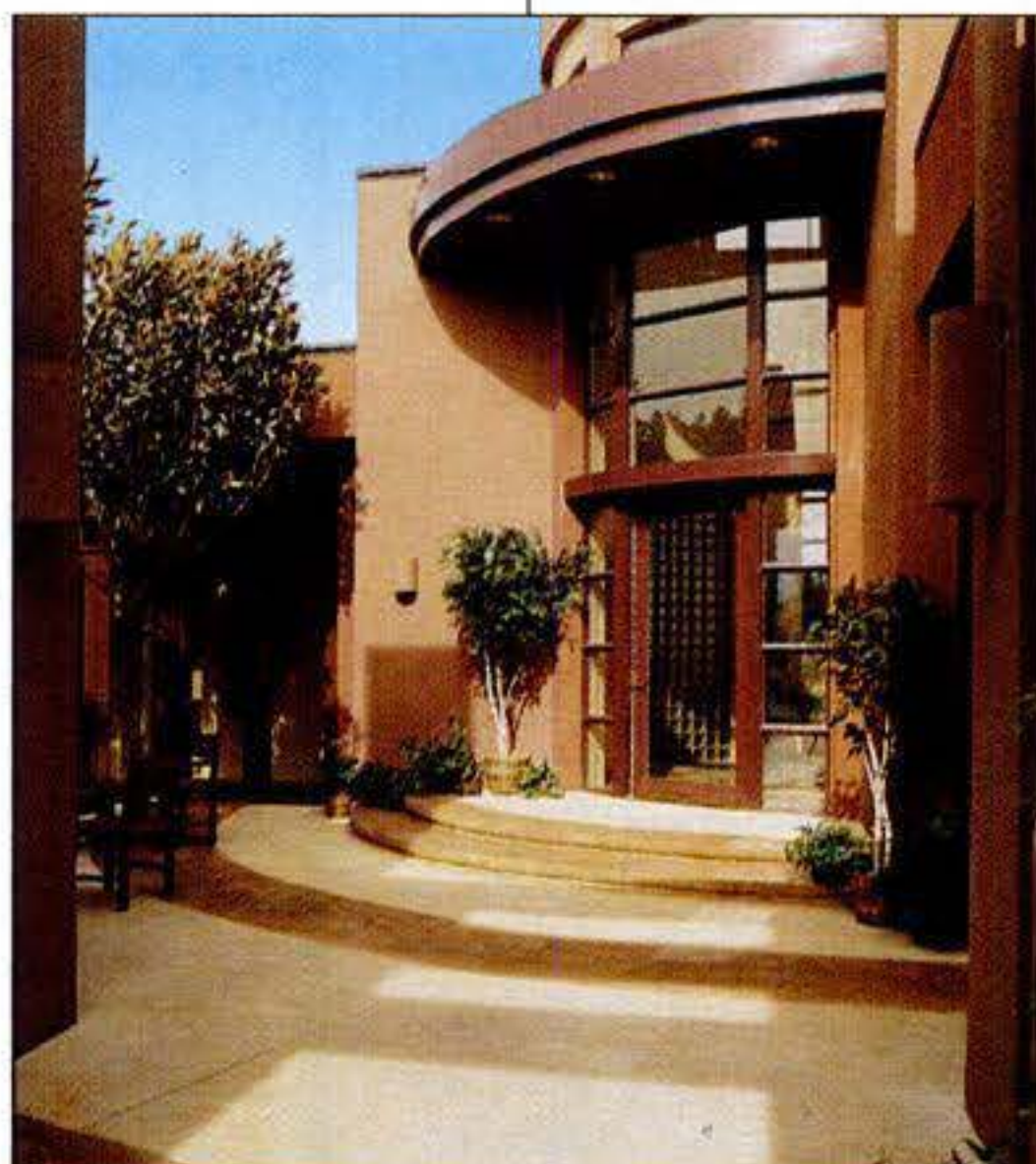
65

Carbon dioxide is rapidly accumulating in the atmosphere, posing a threat to the world's climate. So scientists are urgently seeking ways to capture and dispose of the gas. These "carbon fixation schemes" face daunting technological and economic challenges.

THE NEW AMERICAN HOME '94

72

Welcome to a state-of-the-art demonstration of the possibilities for a home. This amazing, adaptable 5,000-square-foot showcase proves how far a dwelling can go with innovative, off-the-shelf technology. Indeed, the house seems to anticipate your needs through a control system that has "adaptive intelligence."



72

New American home

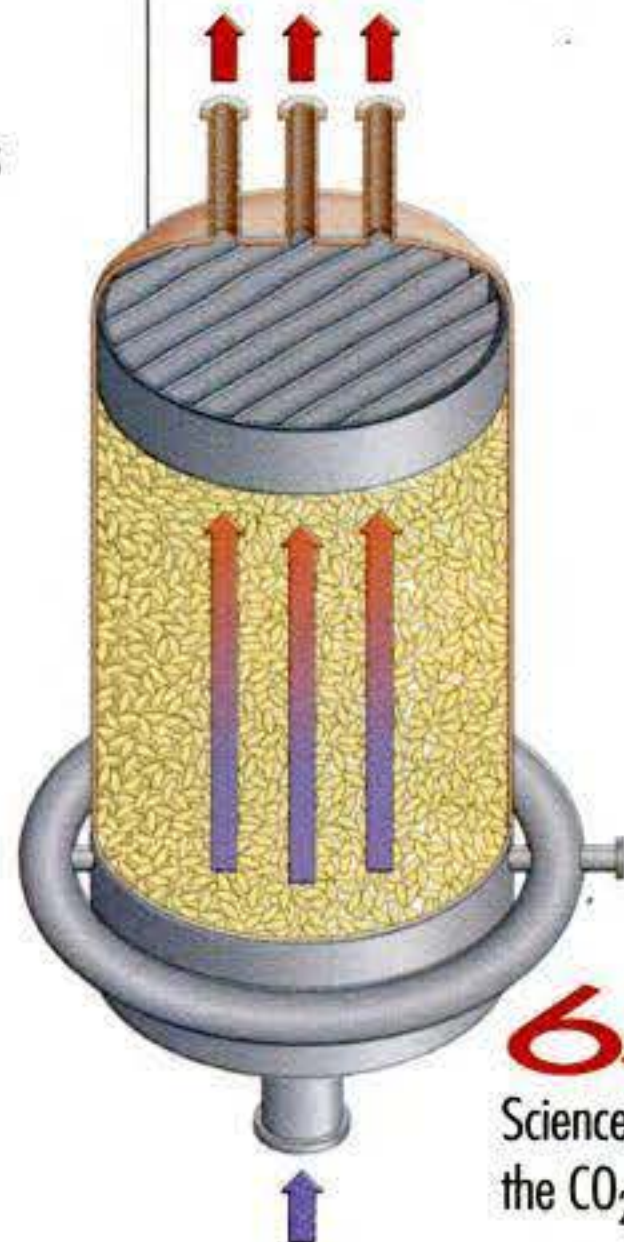


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Heavy haulers

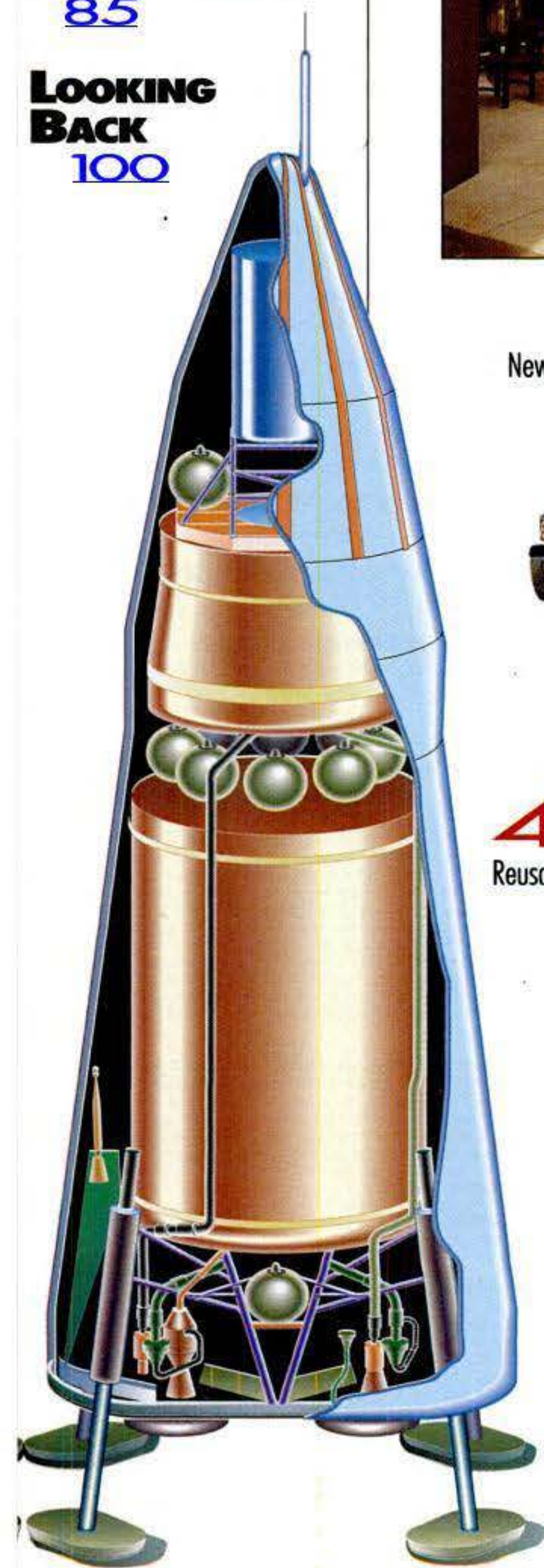
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Reusable rockets



65

Science gets
the CO₂ out



SPACE TRAVEL: THE NEXT GENERATION

I watched Alan Shepard's historic launch into space—America's first manned space shot in May 1961—on a dinky black-and-white television, set up in front of my sixth-grade classroom. Though brief, the mission was seen as a jubilant success by most of the nation. I was distraught. Watching Shepard being fished out of a funnel-shaped capsule on the verge of sinking to the bottom of the choppy Pacific Ocean, I wondered: Where was the rocket ship? Didn't Jules Verne, the 1950 movie "Destination Moon," and countless other prescient tales of our future among the stars tell us that we'd travel in space ships that could not only leave the earth but return as well?

Some 30 years later, in the Arizona desert, American astronautics has demonstrated that we are on the verge of fulfilling this classic vision of a reusable rocket ship. The stuff of Buck Rogers and Flash Gordon is no longer science fiction. The Delta Clipper—albeit a one-third size, unmanned test version—lifted its bullet nose toward the sky and moments later, descended tail first, extending its landing gear and firing its rocket engines to make a pillow-soft landing. Now, that's what I call space travel.

In this month's cover story, Senior Editor Stuart F. Brown reports that fully reusable spacecraft make enormous sense. In fact, they are beyond doubt our best hope for the exploration of space with anything that approaches cost efficiency. And yet, despite this breakthrough, the DC-X project is at risk. Following last fall's series of successful test flights, funding ran out. It will take billions of dollars to fully test the DC-X, as well as a second, larger prototype and, finally, a full-scale Delta Clipper capable of carrying astronauts to, say, a space station or the moon.

The good news is that the tests have bolstered the chances of future funding for single-stage-to-orbit research. In December, NASA, the Air Force, and the Defense Department's Advanced Research Projects Agency were putting together a plan to present to Congress. We'll keep you posted: We think the development of a new launch vehicle, one that will replace the space shuttle, is long overdue if the U.S. is to remain a world leader in space exploration.



Rocketman: Senior Editor Stuart F. Brown inspects the engine exhaust nozzles of the DC-X.

By the time you read this issue, the 14 millionth Macintosh computer will have been sold. The Mac is by no means the best-selling personal computer in history, but in its relatively brief 10-year history, it is arguably the most influential, the most loved, and the most legendary. Author Steven Levy has written a new book on the occasion of the Macintosh's tenth anniversary, called *Insanely Great*. That was the phrase Apple co-founder Steve Jobs used to characterize the revolutionary machine he was to unveil on January 24, 1984.

In an article adapted from his book, Levy takes us back to Silicon Valley in the time when Macintosh was merely a collection of ideas in a notebook. His behind-the-scenes story describes the people, the vision, and the events that led to the birth of the Macintosh, a computer that, as Levy says, has made a dent in the universe.

One of the latest Macintosh computers, the Macintosh TV, is at the center stage in the New American Home, a building project whose design we're proud to have co-sponsored once again, along with the National Association of Home Builders. But the Mac TV is only one of a host of new and innovative ideas that are incorporated in this year's show house. Contributing Editor Michael Morris' article takes you on a guided tour of this tour de force of advanced home technology in the Nevada desert.

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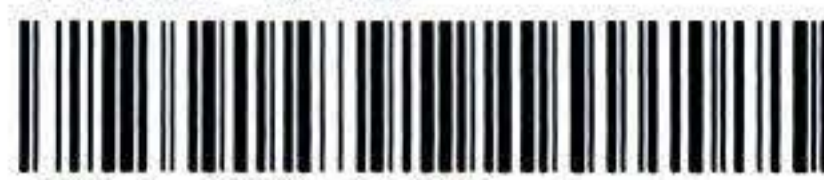
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READERS TALK BACK

TRASHING 'TRASH' GENES

The concept of "trash" genes, defects that harm the elderly, has merit ["Can We Live to 150?" Nov. '93]. But your statement that "there is no way to breed such 'trash' genes out of the population" isn't entirely accurate. Some past societies accomplished selective breeding by exiling or putting at social disadvantage those with certain ailments, thereby making them unable to reproduce. A high-tech society that is capable of detecting trash genes could someday resort to low-tech solutions, such as sterilization or euthanasia.

Lawrence T. Beckerle
Craigs ville, W. Va.

ENGINEERED TO PERFECTION

Thanks for bringing a human-powered vehicle onto center stage with "The World's Fastest Bike" cover story [Oct. '93]. With the technology that goes into today's bike design, you can understand why this generation of two-wheelers doesn't resemble your daddy's Schwinn.

Guy Ben-Moshe
Austin, Texas

THE WHICH MANEUVER?

The so-called Herbst maneuver illustrated in Science Newsfront [Dec. '93] seems to be the same one that was first executed by a German officer, Immelmann, during World War II. It was called the Immelmann turn, and has since then been practiced by many pilots flying all types of aircraft, including gliders.

Lancelot J. Kethley
Portland, Ore.

In an Immelmann turn, the pilot performs the first half of a loop, which leaves the plane inverted in level flight. He then does a half-roll to end right-side up at a higher altitude, but with a lower airspeed than when he went into the turn. In the Herbst maneuver, however, the X-31 jet is stood

on its tail, in a manner that would cause an ordinary plane to lose control, by stalling the airflow over its control surfaces. The X-31 can do this because it has thrust vectoring and front canards that provide a wide range of motion.—Stuart F. Brown

FILTER FOR AUTO-POLLUTANTS

I have another idea for the polymer membrane, which is being developed at the University of Texas at Austin to eliminate oxygen from food-storage areas to prevent spoilage [Home Newsfront, Oct. '93]. It could also be used in the air filters of internal-combustion engines to reduce the amount of nitrogen reaching the combustion chamber. This could in turn cut the amount of polluting oxides of nitrogen in the engine exhaust. In addition, this might permit combustion at higher compression and higher temperatures for greater efficiency.

Frederick Schmutge
St. Paul, Minn.

EXPLAINING DIGITAL DIFFERENCES

Time sampling is not a digital process, as you imply ["Swept Away by the Digital Age," Nov. '93]. It is an analog process exactly akin to amplitude modulation—except that the carrier is an infinite string of vanishingly narrow pulses, rather than a sine wave. While it is the first step in digitization, it does not convert an analog signal to digital. It is the quantization of the samples—turning them into ones and zeros—that represents true digitization.

William Sommerwerck
Bellevue, Wash.

Reader Sommerwerck is correct in stating that time sampling by itself, without quantization, is not digital. However, I was not asserting that it was. Instead, I was pointing out its relationship to the averaging and compression that are key parts of the digital process. The point is that a series of pulses, no matter how "vanishingly narrow," implies that there are spaces between them, or gaps in the capture of real-world events.—Robin Nelson

Correction: The Hubble Space Telescope is 42.5 feet long and weighs 12.75 tons [Dec. '93].

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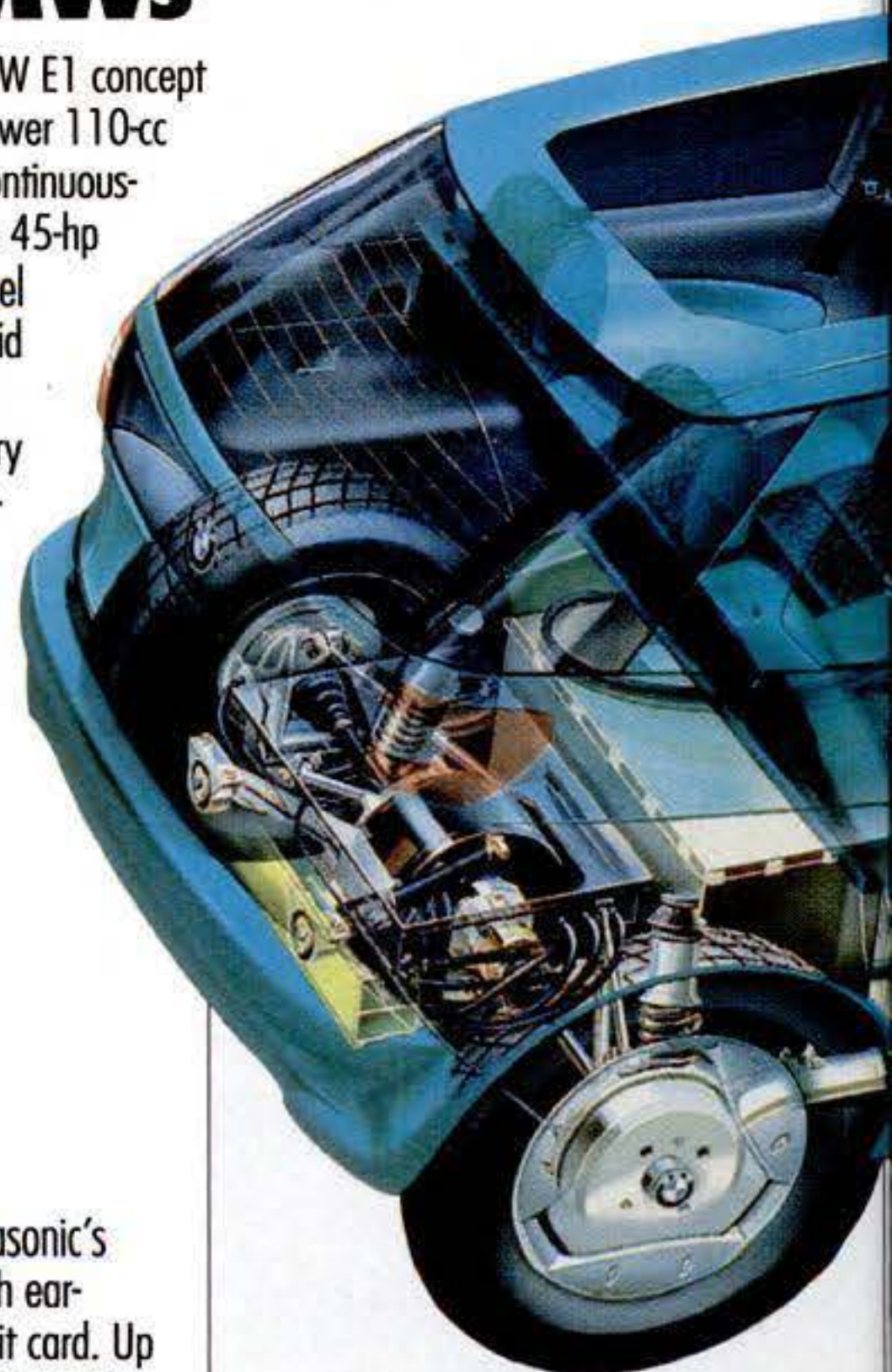


HANDHELD ORGANIZER

Equipped with spreadsheet and word processing capabilities as well as digital voice recording, the pocket-size Psion Series 3a Personal Information Manager lets you schedule appointments and annotate them with brief voice messages. Files may be downloaded into a desktop computer via a serial link. The \$500 organizer runs for approximately two months on two AA batteries.

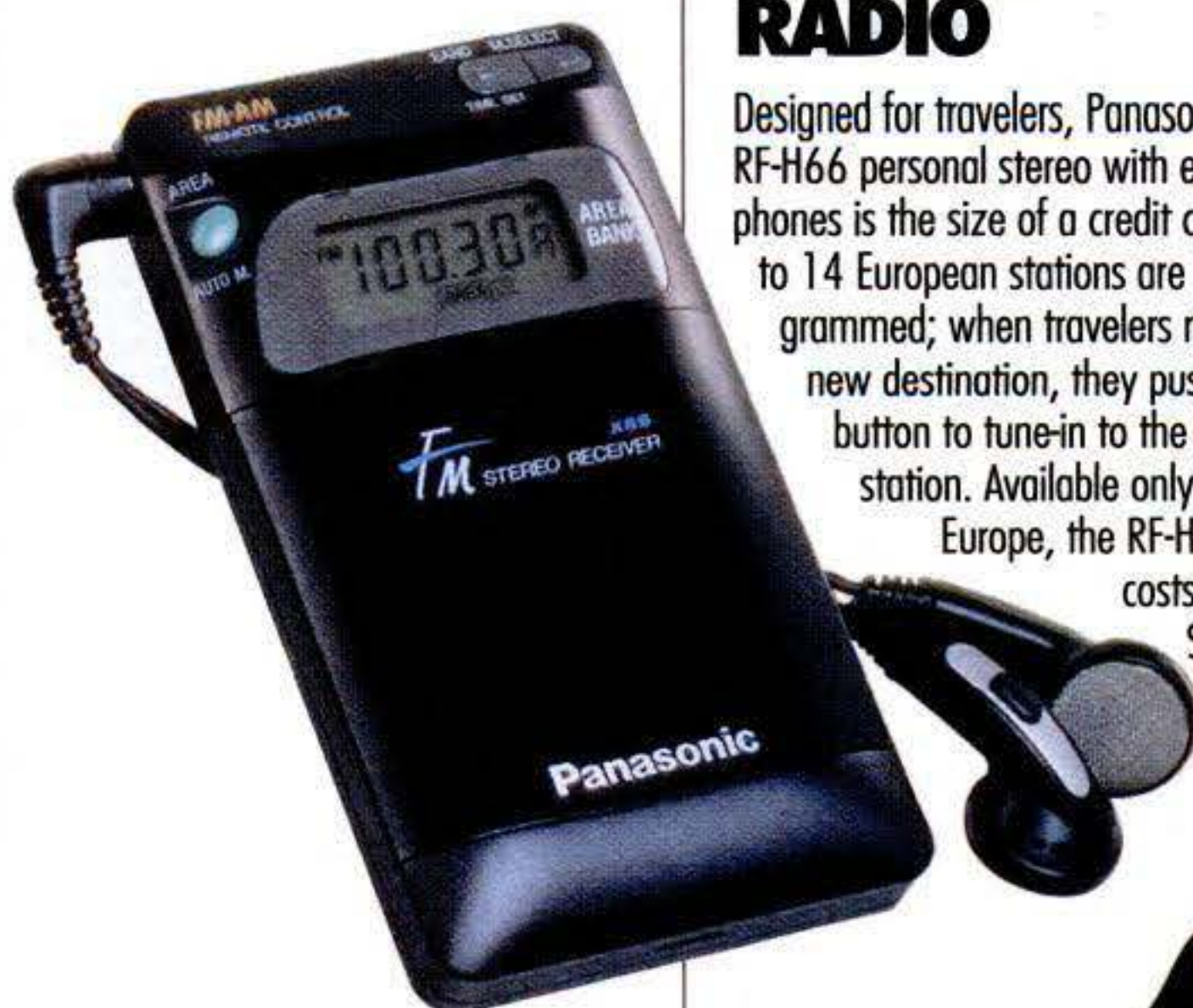
BABY BMWs

Updated versions of the BMW E1 concept city car have an 81-horsepower 110-cc motorcycle engine with a continuously variable transmission or a 45-hp electric motor with rear-wheel drive—or both, in the hybrid version. A high-temperature sodium-nickel-chloride battery would give the electric model a 165-mile range. The gas-engine model could be available in Europe in four years.



TRAVEL RADIO

Designed for travelers, Panasonic's RF-H66 personal stereo with earphones is the size of a credit card. Up to 14 European stations are preprogrammed; when travelers reach a new destination, they push a button to tune-in to the nearest station. Available only in Europe, the RF-H66 costs about \$100.



NO-SWEAT BIKING

Bolt the Zap Power System onto the front of a bicycle, and the electric motor drives the front wheel for a top speed of about 20 mph. The \$400 unit recharges in four hours with a standard 12-volt recharger or optional \$60 portable recharger. One charge lasts about 20 miles. McGreen Development, Box 1217, Alameda CA 94501.



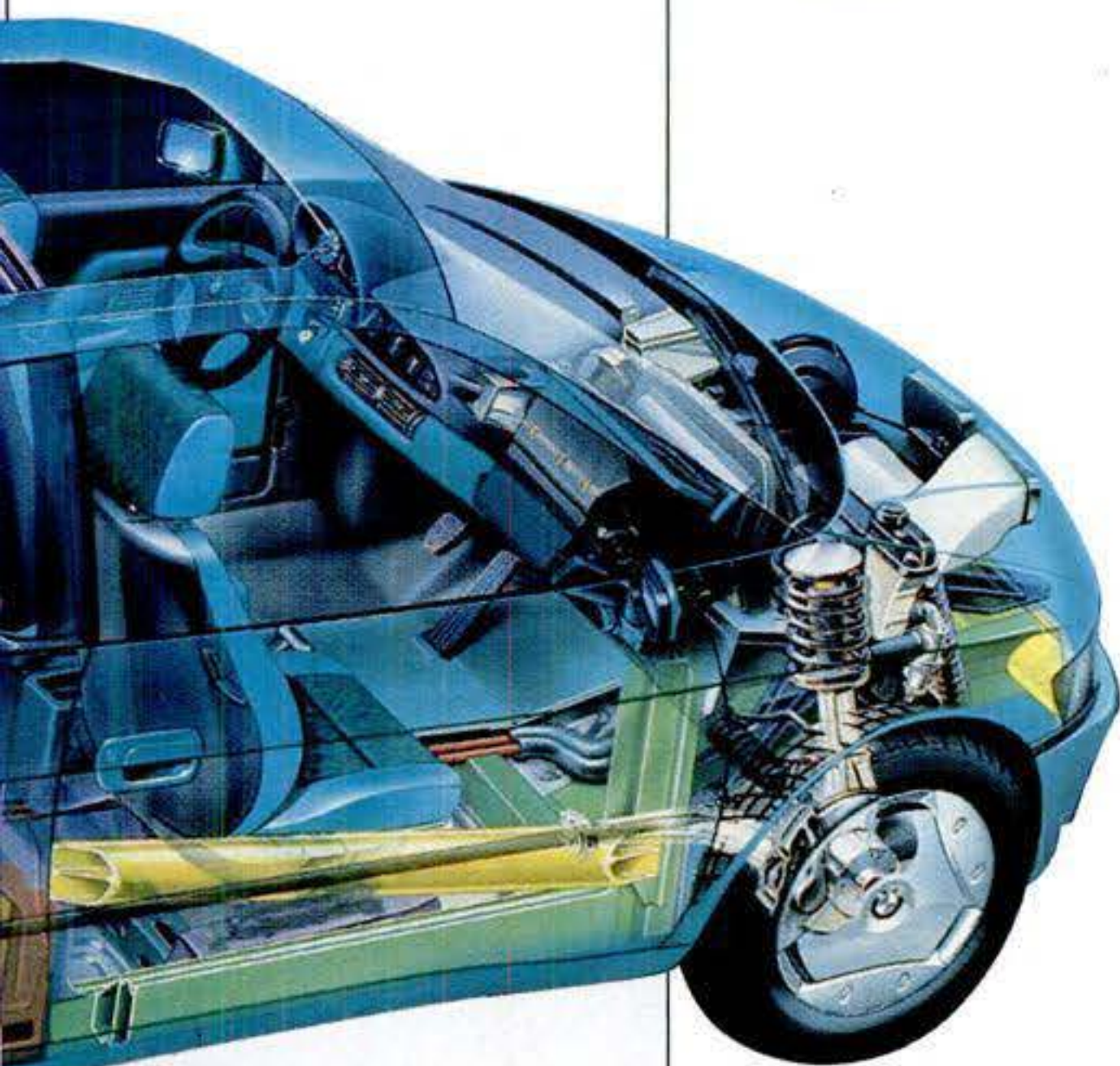
INTERACTIVE MUSICAL INSTRUMENT

It resembles a guitar, but The Key has a keyboard instead of frets and "strummer veins" instead of strings. You can use the electronic instrument by itself, or insert ROM packs that let you play along with (or modify) songs. You can also plug the device into the VCR for use with specially encoded musical video tapes. Price: \$400. Lonestar Technologies Ltd., 920 S. Oyster Bay Rd., Hicksville NY 11801.



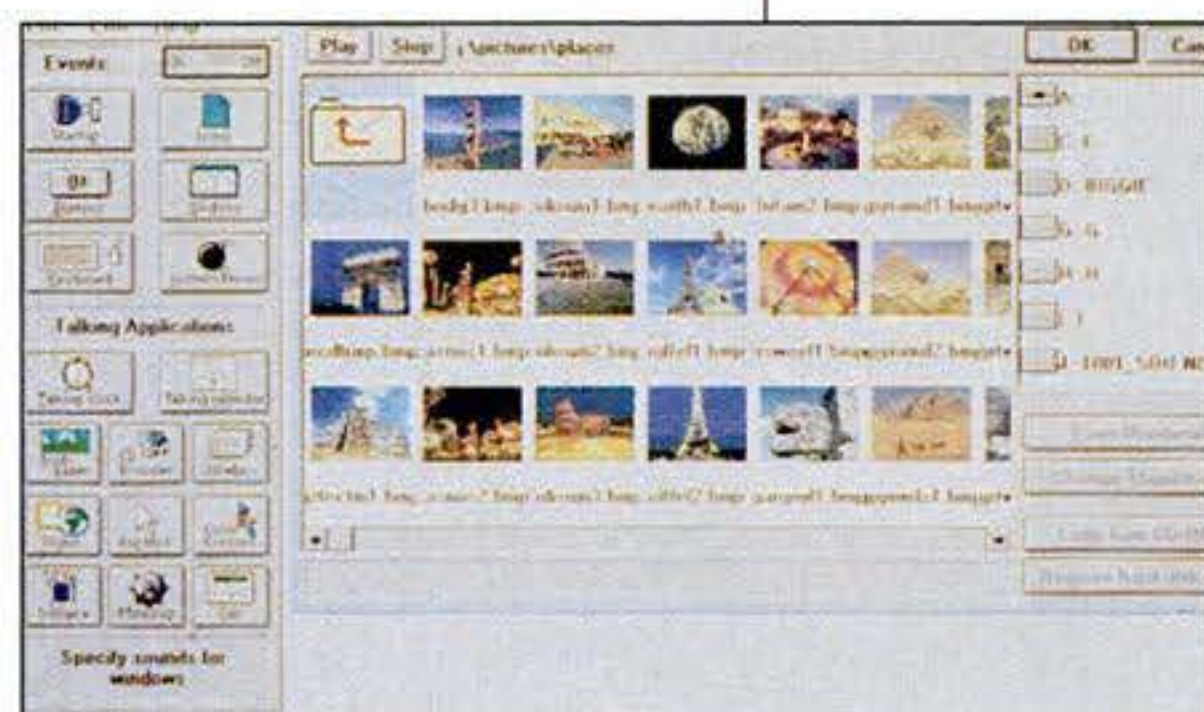
QUICKER GRIPPERS

Quick-Grip spring clamps require less pressure to open their jaws than other clamps, without a loss of clamping power. The clamps, which range from a \$3 one-inch version to a \$7 three-inch version, also have a smaller hand span, making them easier to use. American Tool, Box 337, DeWitt NE 68341.



HIGH-SPEED GAMING

Instead of cartridges, the Amiga CD32 interactive machine uses optical discs to play video games and educational software. The system hooks up to a TV and uses a 32-bit processor (as opposed to 8- or 16-bit processors) and four custom-designed chips to handle video, graphics, and sound. Price: \$399. Commodore Business Machines Inc., 1200 Wilson Dr., West Chester PA 19380.



WINDOWS, YOUR WAY

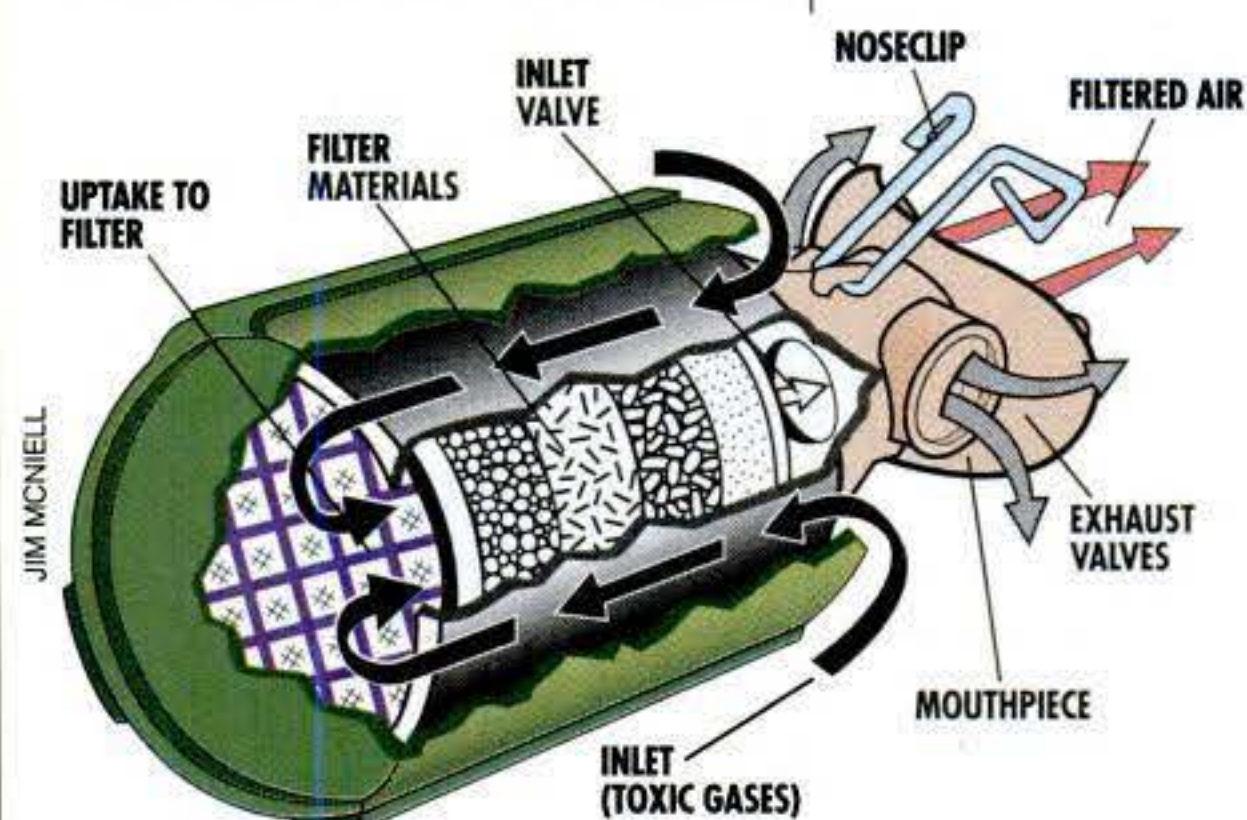
Customize your Windows desktop environment with CD-Blaster CD-ROM's realm of options: 2,000 sound effects, 300 MIDI files, 400 talking icons, 100 designer cursors, 200 photographs, and 150 video clips. Settings are easy to change. Price: \$40. Aristo-Soft, 7041 Koll Center Pkwy., Pleasanton CA 94566.



COMPUTERIZED TV

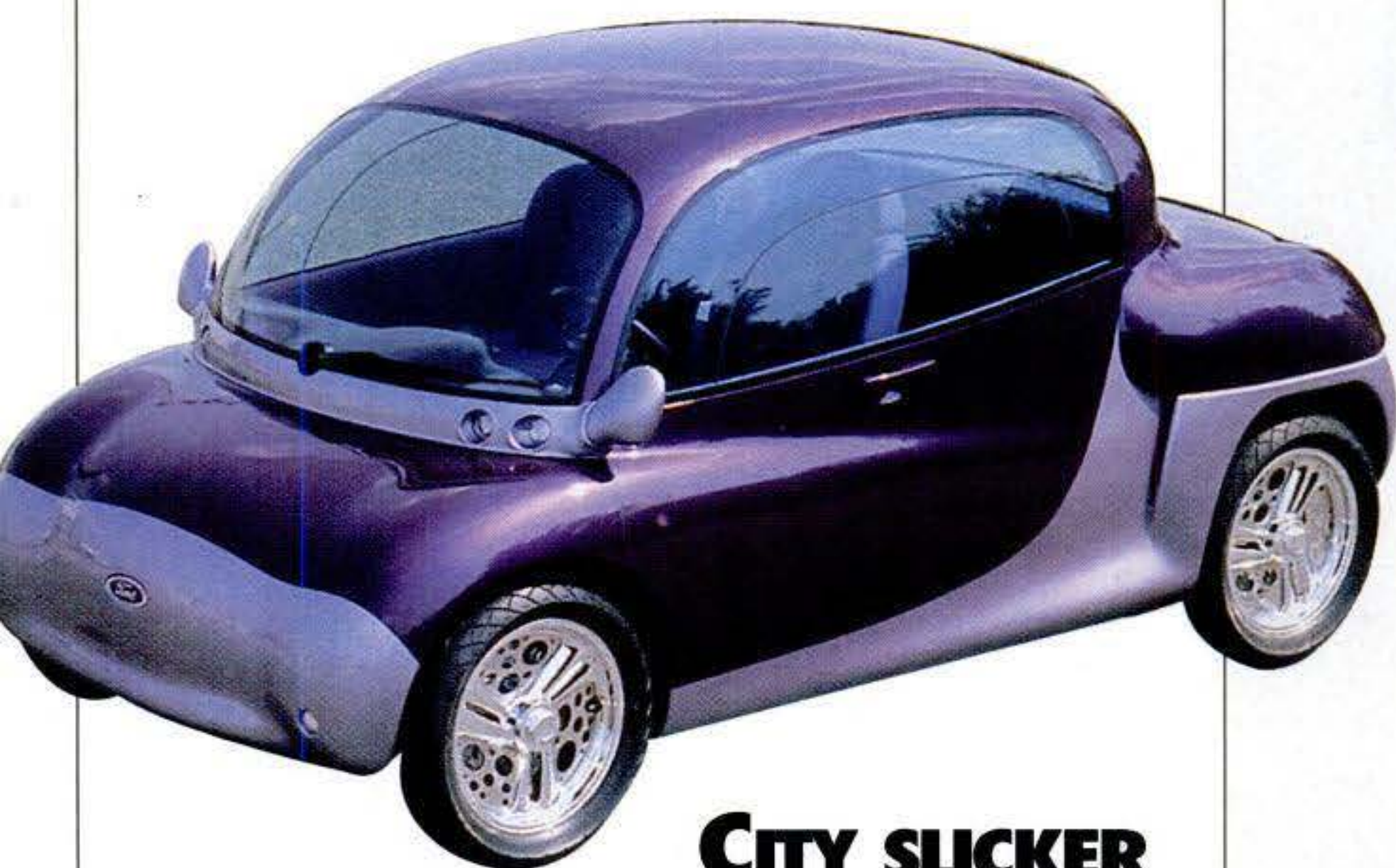
Apple gave the Macintosh TV a coaxial cable port, audio and video jacks, and a remote control to make it work like a television, plus all-in-one styling and a 14-inch color display to make it look like one. The unit is also a computer, however—it's equipped with a 68030 processor running at 32 megahertz on a 160-megabyte hard drive. Price: about \$2,000.

WHAT'S NEW



SMOKE-FREE HOOD

The EVAC-U8 is the only safety hood that protects against carbon monoxide, hydrogen cyanide, hydrogen sulfide, and other toxic fumes. Its unique mouthpiece has a three-valve system that provides freshly filtered air for up to 20 minutes. The soda-can-size luminescent unit weighs 11 ounces and its hood withstands temperatures to 1,500°F. Price: \$60. Safety First, Ste. 211, United Airlines Bldg., Seattle WA 98121.



CITY SLICKER

Fuel efficiency and ample cabin space mark Ford's European ultracompact 11-foot Sub-B city concept car. It gets 46 mpg in the city and is powered by a 1.2-liter, 82-horsepower Orbital two-stroke engine mounted at the rear. Its automatic transmission is controlled by push buttons. The top speed is 100 mph.

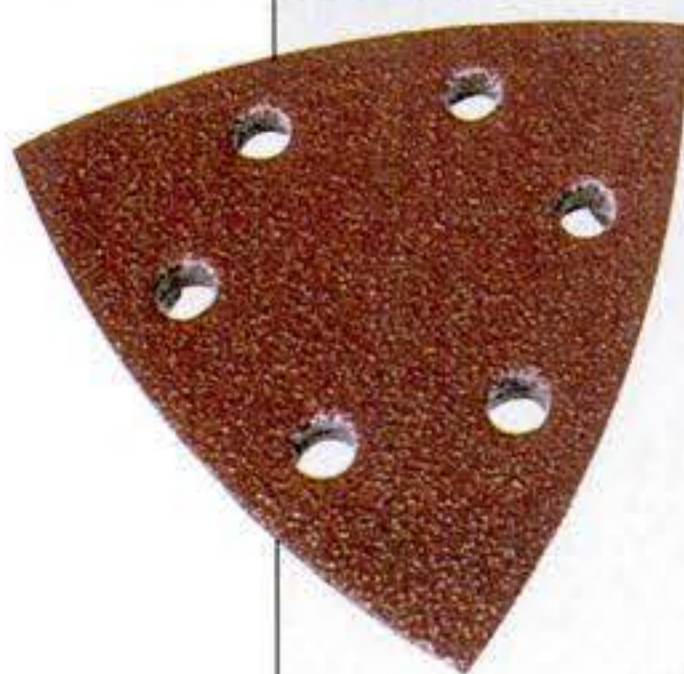
GEOMETRIC BIKE

Custom-made by specialists in aerospace components, the all-terrain dual-suspension Genesis bicycle is built with a one-piece, 3.5-pound composite frame with titanium reinforcements; the total weight is just 25 pounds. The British-designed bike sells for \$3,500 to \$4,000, depending on specifications. SP Systems, 741 Flynn Rd., Camarillo CA 93010.



EXTENDED-USE DETAILER

The head of the Bosch B7000 corner/detail sander rotates to three positions for even wear and extended use of the 3.5-inch triangular sanding pads. It operates at 13,000 orbits per minute. Price: less than \$100. S-B Power Tool Co., 4300 W. Peterson Ave., Chicago IL 60646.



DIGITAL SLIDE SHOW

Lay this eight-pound tablet on an overhead projector, insert a disk, and watch the wall as the IntelliView executes a color Windows presentation with digital sound and video. The wireless remote is also a mouse pointer. Slides can be retrieved remotely through the serial port or PCMCIA slot. Price: \$5,995. IntelliMedia Corp., 455 Riverview Dr., Benton Harbor MI 49022.





TEN-POCKET POOL TABLE

How do you play Total Fusion pool? Follow traditional pool rules, but rack the balls in two groups of seven, with the eight ball in the middle. This two-in-one pocket billiard table costs approximately \$4,800. Northfield Cabinet Shop Inc., 4780 Old Highway 45, Conover WI 54519.

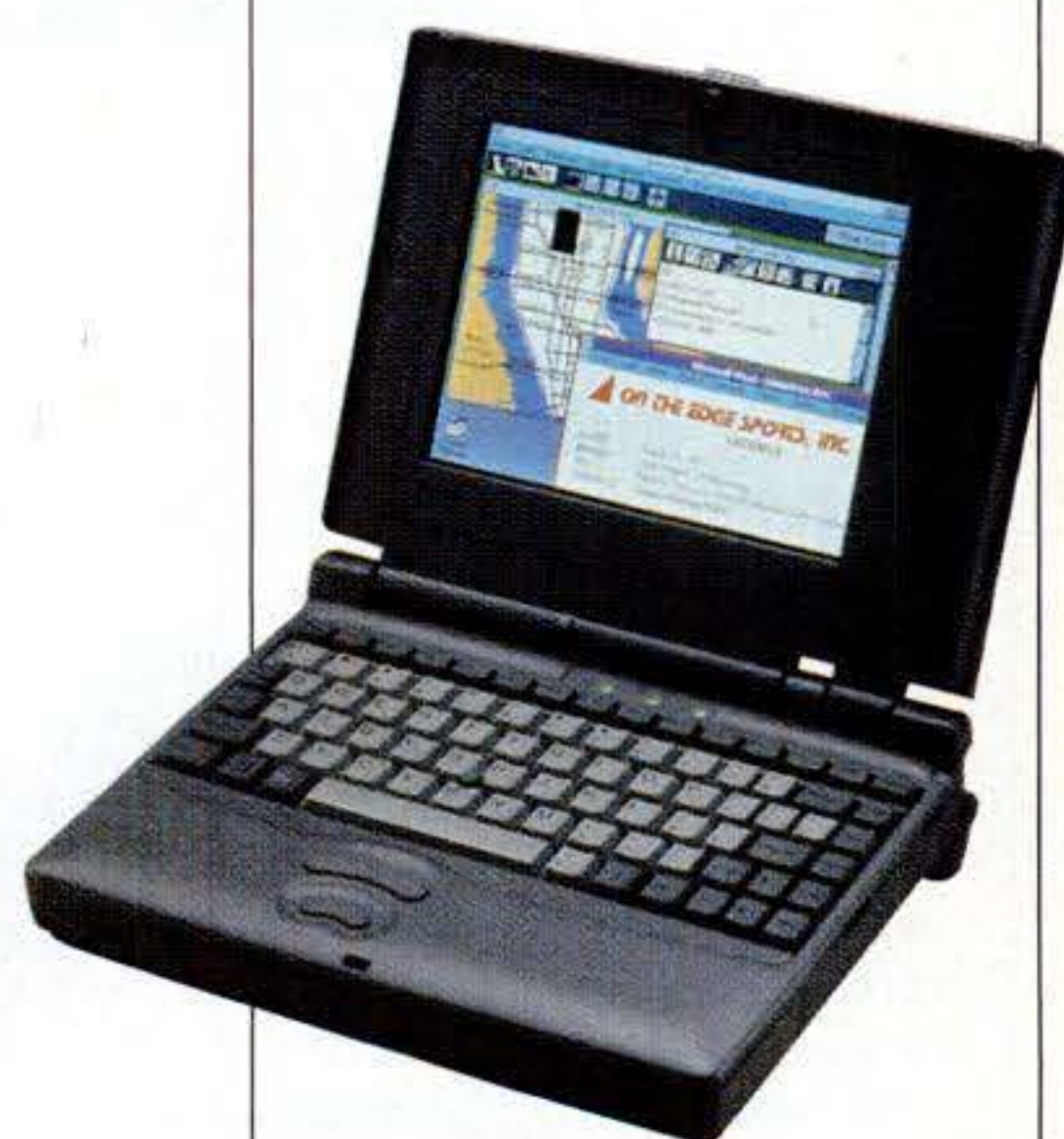
SLIDES ON TELEVISION

View your slides, photos, and negatives on TV with Fuji Photo Film's Fotovision FV7. The Fotovision uses a $\frac{1}{3}$ -inch charge-coupled device to transform the photographic images into TV images. An optional digitizer also stores the data on floppy disks. The \$680 system is available only in Japan.



VOICE BOX

The first daily-planner software to operate by voice commands, multimedia Personal Daily Planner organizers store and display 450 still video images and 50 video clips. A built-in "assistant" (an on-screen video character that you customize) reminds you of important dates. Developed by Iguana Productions and distributed by Media Vision, the software costs \$60 on a CD-ROM disc or \$50 on floppy disk.



THE FIRST WITH COLOR

The Toshiba Portégé T3400CT is the first subnotebook with a color active-matrix display and the first computer of any kind to be powered by the long-lasting lithium battery. The 4.4-pound unit also features an integrated pointing device and one PCMCIA Type II slot. Price: \$4,000.



SAFETY AT HIGH SPEED

The Opel Tigua features a twin-cam 16-valve engine that delivers 109 horsepower for a 0-to-60-mph time of less than ten seconds and a top speed of 120 mph. Safety features include dual air bags and side-impact protection beams in the doors. Vauxhall Motors' Tigua may be available in Europe by 1995, but there are no plans for U.S. sales.

WHAT'S NEW



HOME GYM

The XL-100 exercise machine features a computerized display and built-in software that prompts you through six preprogrammed courses, such as "Walk in the Park." Five individual workouts can also be saved. Price: \$4,995. Cross Conditioning Systems Ltd, 1898 South Flatiron Court, Boulder CO 80301.

SUPERSIZE CARGO PLANE

The A300-600ST Airbus Super Transporter holds up to 1,400 cubic feet of cargo—enough to accommodate aircraft sub-assemblies. With a maximum payload of 45.5 metric tons and a maximum range of 1,296 nautical miles, the A300-600ST is scheduled to enter service in 1995, when it will replace Airbus's aging Guppy 201 transports.



OMNI-PAGER

AccessCard, a pager card in PCMCIA format, receives messages whether it's in or out of your computer. The unit comes with an LED display that notifies you when a message has been received. Some models are available with up to 512 kilobytes of flash memory. Price: less than \$400. Wireless Access, 125 Nicholson Lane, San Jose CA 95134.



THE VIEW FROM ABOVE

An improved liquid-crystal material and a new crystal molecule arrangement more than double the vertical viewing angle in new LCDs from Sharp. The technique gives a vertical viewing angle of 80 degrees without compromising contrast or brightness. Applications may include hang-on-the-wall TVs and computer monitors.



CONTINENTAL GUMPTION

The latest Bentley Continental R features a 6.75-liter turbo V8 that produces nearly 400 horsepower—a 20 percent increase. This clips the car's 0-to-60 mph time to just 6.2 seconds and pushes its top speed to 152 mph. Power gains are matched in the drivetrain by a shift energy-management system that adapts the shift pattern of the automatic transmission to the driver's style. Price: \$270,000.



PARK WAY

Just 8.8 feet long, the Hotzenblitz compact electric city car is designed for maneuverability. Its 16-horsepower motor drives the front wheels and feeds off a mid-mounted zinc-bromine battery pack. The 1,540-pound vehicle has a range of 125 miles and top speed of 75 mph. The car is available only in Europe.

A NEW WAY TO STABILIZE

Nikon's VN-550 camcorder employs a new image-stabilization technology that uses two sensors and works with a 10X power-zoom lens for close-up, shake-free videos. The camera also boasts a color viewfinder and four preprogrammed auto-exposure modes. Price: \$1,500.



COLOR TO GO

Hewlett-Packard's DeskJet 310 for PCs and the DeskWriter 310 for Macintoshes are the first color-capable battery-powered printers. These 300 dot-per-inch printers output three black-and-white pages a minute or one color page in four minutes. The \$379 machines print up to 100 pages per battery charge.

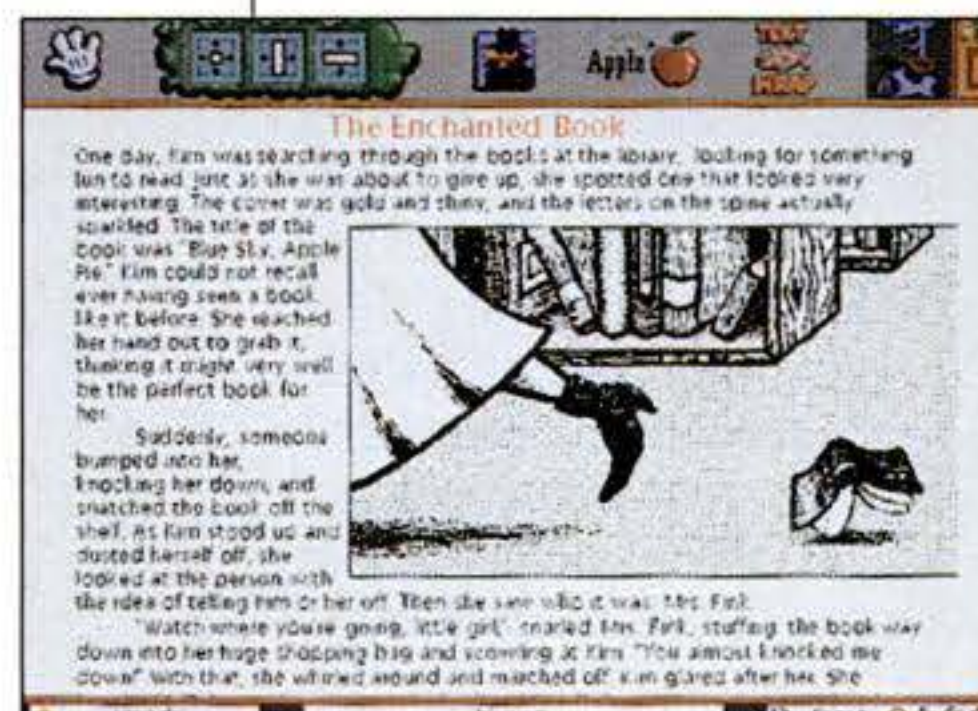


ANTENNA WITH A SWIRL

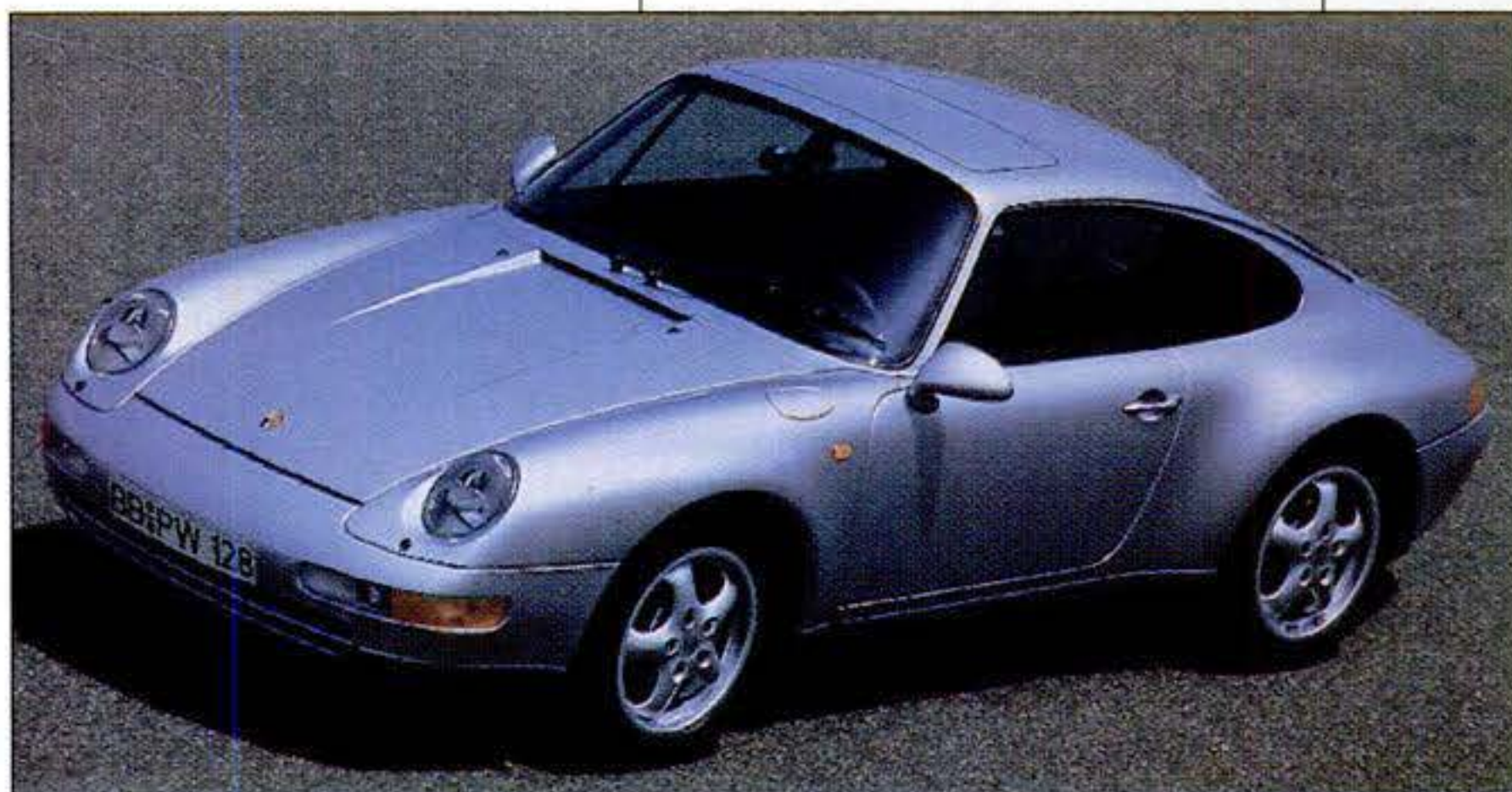
Recoton's TV 800 amplified indoor antenna features a spiral antenna element that receives a consistent signal across all channels and stations. The antenna hooks up to a TV or stereo for improved picture quality and sound reception. Price: \$100. Recoton, 46-23 Crane St., Long Island City NY 11101.

CREATIVE KIDWARE

Microsoft brings its software expertise to youngsters with two new programs for PCs with Windows, or for Macintoshes: Creative Writer (shown) and Fine Artist. Each prods the inventive instincts of children through colorful screens, animated characters, sound effects—and no instruction manuals. Price: about \$65 each. Microsoft Corp., One Microsoft Way, Redmond WA 98052.



WHAT'S NEW



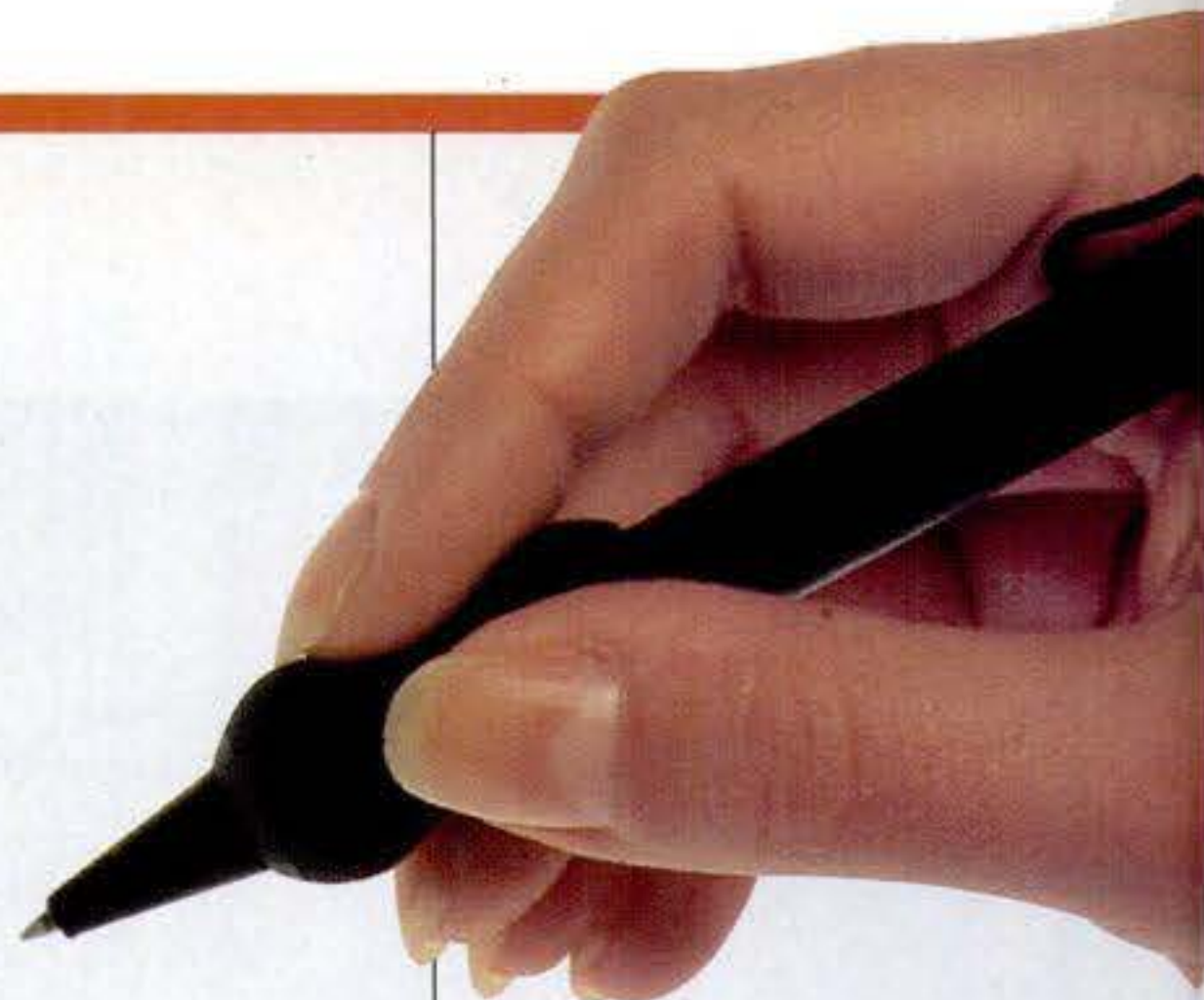
UNDER-THE-SKIN REDESIGN

The Porsche 911 Carrera has a reworked 3.6-liter flat-six engine that boosts its horsepower rating by 20—to 270, giving the car a 169-mph top speed and a 0-to-60 mph acceleration time of just 5.7 seconds. Bosch's latest ABS-5 antilock braking system makes its debut on the Carrera, and it is combined with an advanced computer program to give the car greater stopping power.



LOOK AND LISTEN

Schneider's "Boston Plus" is the first high-fidelity stereo system to include a liquid-crystal display that uses text and graphics to show track titles and operating information, such as bass, treble, balance, and volume levels. The display folds down when not in use. The system is available only in Europe. Schneider Rundfunkwerke AG, Silvastrasse 1, D-86842, Turkheim, West Germany.



PLUSH PEN

The prototype Grip Ease pen has a semisoft rubber grip that's designed to prevent calluses. The grip accommodates the thumb and fingers to reduce the wrist strain and finger fatigue that can come with extended use of traditionally shaped writing implements. Inventor Stanley C. Luke Jr. of Westbury, N.Y., says that a mechanical pencil version may also be available in the future.



PLANE STOPPER

This new runway-overrun system being developed by the Federal Aviation Administration can halt a 727 aircraft moving at 80 mph in a mere 540 feet. Consisting of an 18-inch-high bed of stiff foam that drags the airplane to a standstill through friction, the system could be ready for use this year. It could be a lifesaver for emergencies at airports like New York's LaGuardia, where short runways end abruptly in front of highways or bodies of water.



LOOK AND LISTEN—AGAIN

JVC's XM-D1 portable MiniDisc digital recorder/player features an adjustable pop-up liquid-crystal display. Using the keypad, you program tracks in any order, then view the selected information on screen. A built-in dial allows for audible song searching. It is available in Japan only, for about \$950.

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WHAT'S NEW

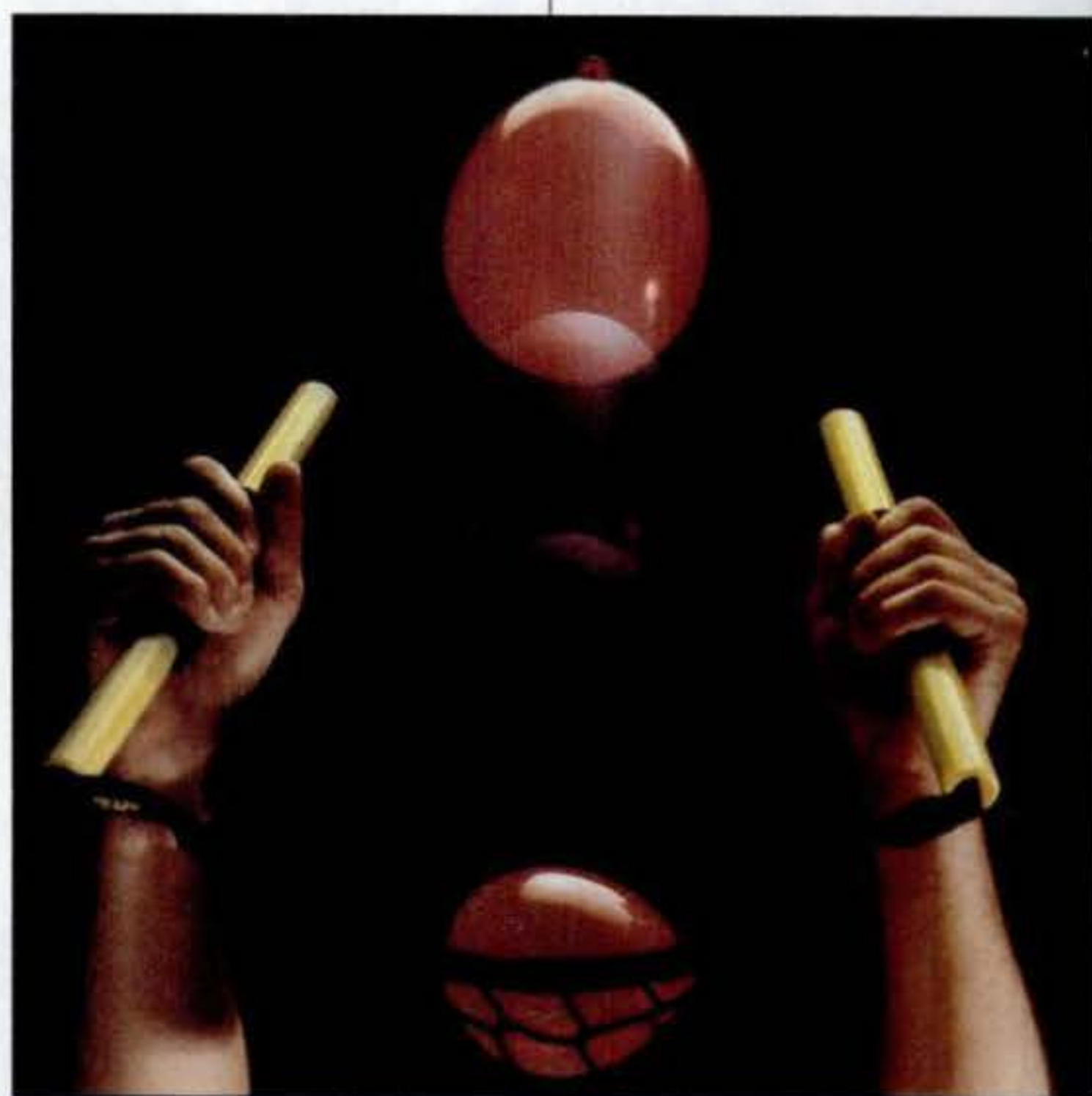


UNTIPPABLE LUGGAGE

The prototype Outrigger suitcase has a wheel-equipped stabilizing bar that locks into place across the luggage's base to compensate for uneven weight distribution. When not in use, the bar swivels back into its original position. I.B.B. Ltd., Box 568, Chappaqua NY 10514.

TWISTING THE WEEDS AWAY

As you rotate the Garden Claw, its steel tines break up and aerate hard soil. The \$35 tool can also be used to mix fertilizer into soil, cultivate around shrubs, weed between rows in a garden, or aerate compost. Garden Weasel Division, Faultless Starch/Bon Ami Co., 1025 W. 8th St., Kansas City MO 64101-1200.



CATCH!

Trapp ball, an innovative outdoor game, uses two-handled catching-and-tossing equipment. Cradle a ball or water balloon in the net, then pull the handles away from each other to catapult the ball up to 100 feet away. The game costs \$20, including two nets, one ball, and 20 biodegradable balloons. Saturnian I, Box 700538, Plymouth MI 48170.

JUST FOR KIDS

Designed for children ages three to six, Sega's Pico computer has both buttons and a touch-sensitive tablet for input and can use either its own display or a TV screen for a display. Entertaining and educational software featuring animated characters is available on cartridges.

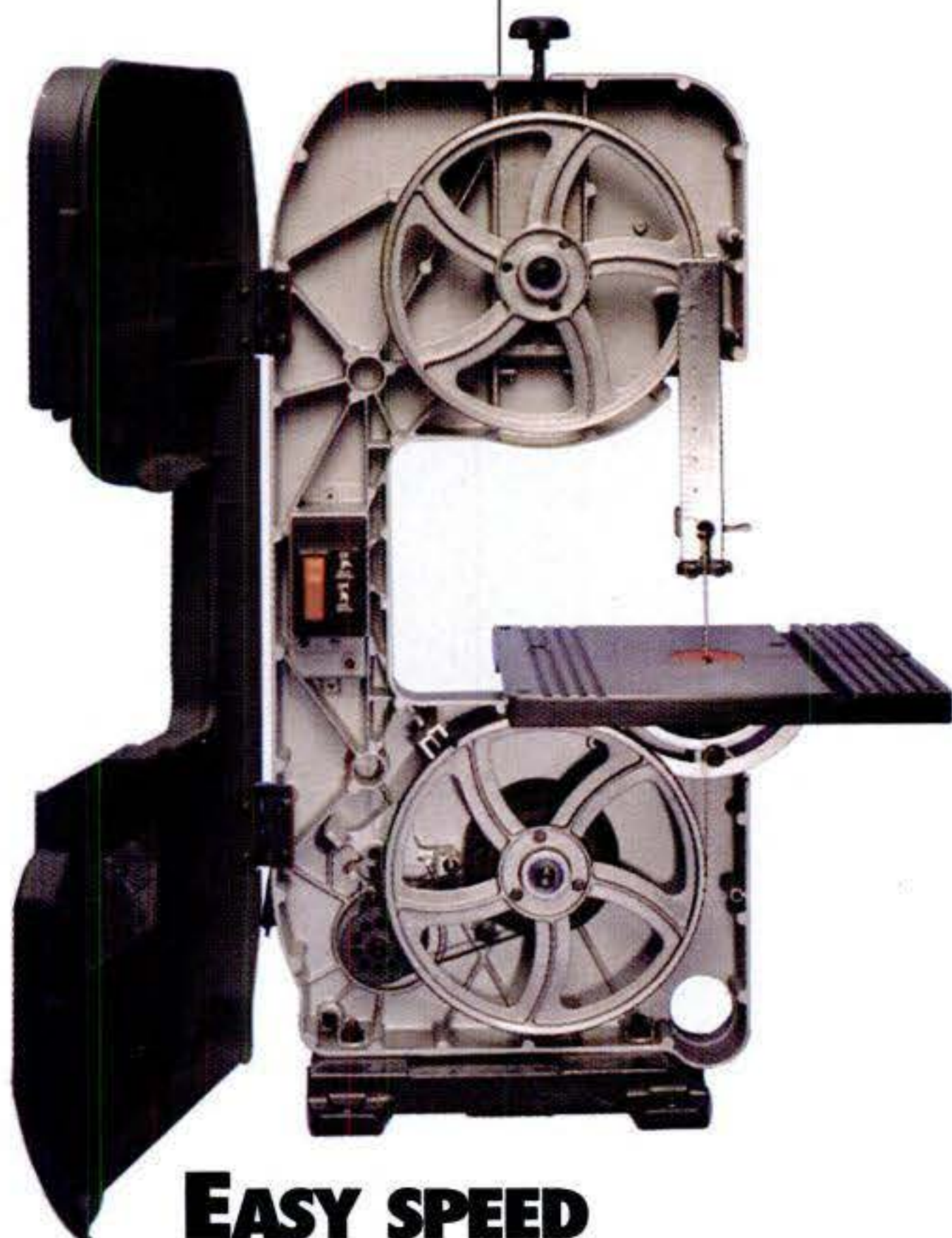
The computer is available only in Japan.



DIM-WATTED BULB

A computer chip in the base of Philips' Dimmer bulb lets you adjust the brightness of any lamp. Just turn the light off and then on to cycle through its four lighting levels—from 20 to 100 watts. Price: \$5.

WHAT'S NEW



EASY SPEED

Dremel's benchtop two-speed band saw adjusts from 900 to 3,000 rpms quickly: Flip open the plastic cover, loosen the drive belt, and slide the belt onto a second pulley. The \$365 saw also features ten-inch throat depth and seven-inch maximum throat height. Dremel, 4915 21st St., Racine WI 53406.



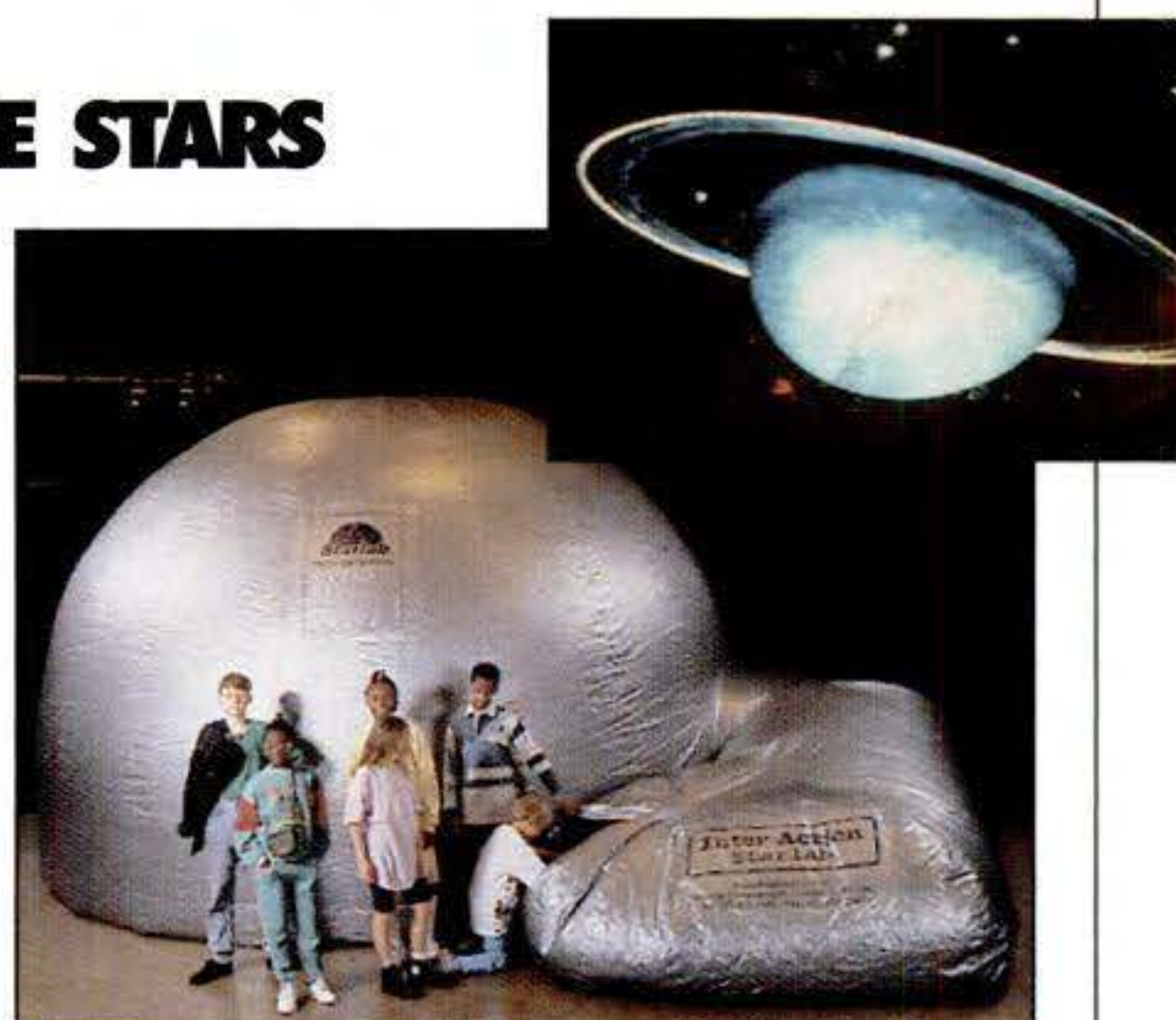
COMPUTER PHONE

Twincom's C-Phone enables people linked by a computer network to make video phone calls. The system delivers full-motion color images with synchronized audio and can be used within a single network of PCs or several networks connected by high-speed phone lines. Mounted on top of a computer monitor, the system costs about \$2,000 per PC. Twincom, 6714 Netherlands Dr., Wilmington, NC 28405.



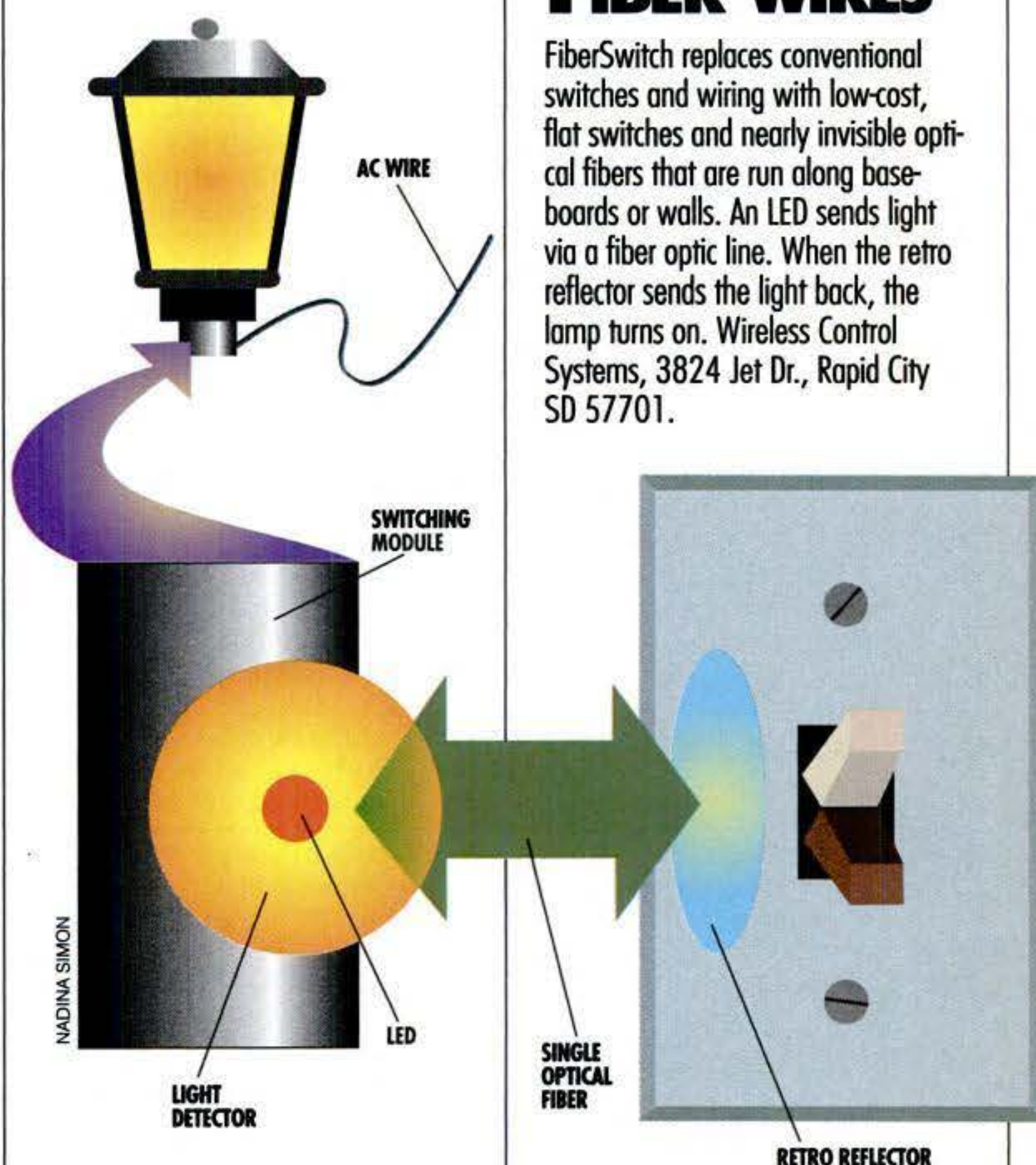
MOBILE STARS

Starlab, a portable planetarium, is an inflatable polymer fabric dome large enough to accommodate up to 30 people. A perforated cylinder rotates slowly around a high-intensity halogen lamp to cast stars and planets on the dome's inner surface. Inter-Action Starlab, Victoria Embankment, London EC4Y 0HJ, England.



FIBER WIRES

FiberSwitch replaces conventional switches and wiring with low-cost, flat switches and nearly invisible optical fibers that are run along baseboards or walls. An LED sends light via a fiber optic line. When the retro reflector sends the light back, the lamp turns on. Wireless Control Systems, 3824 Jet Dr., Rapid City SD 57701.



WRITE WAY

Handwriter for Windows is a digitizing pad that lets you enter words or drawings into your PC with a pen. It includes a set of introductory software that converts handwritten characters into computerized text, interprets editing symbols, and gives the pen mouselike pointing capabilities with Windows programs. Price: \$399. Communication Intelligence Corp., 275 Shoreline Dr., Redwood Shores CA 94065.

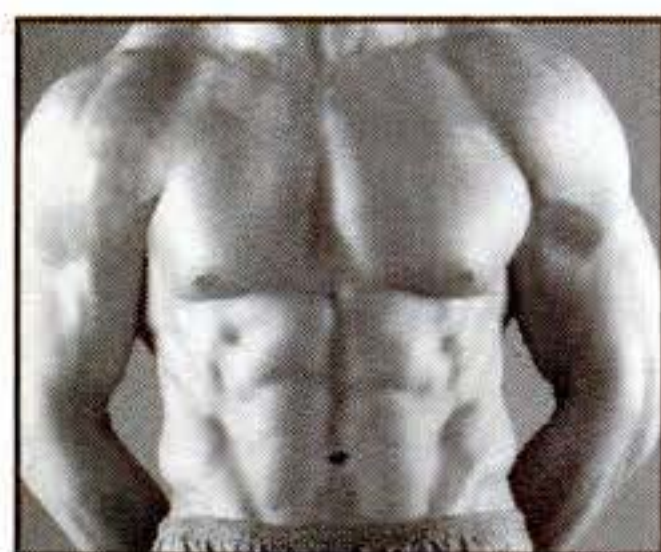
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**Pay in 9 easy
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THE REASONS	HEALTHMAX	SOLOFLEX	NORDICFLEX GOLD
1 Low price	☒ YES \$329 (plus \$49 S/H)	☒ NO \$995 (plus \$105 S/H)	☒ NO \$999 (plus \$99 S/H)
2 Easy to use	☒ YES No assembly/ disassembly required between exercises.	☒ NO Requires assembly/disassembly between exercises.	☒ NO Requires assembly/disassembly between exercises.
3 Leg Extension Unit included	☒ YES Permits both leg extensions and lying leg curls.	☒ NO Costs \$200 extra.	☒ YES, BUT... Leg unit included doesn't permit lying leg curls.
4 Butterfly Unit included	☒ YES No extra cost.	☒ NO Costs \$200 extra.	☒ YES, BUT... You must assemble before each use, and disassemble to use bench press.
5 Strength conditioning for all five major muscle groups	☒ YES HEALTHMAX strengthens all five: arms, legs, abdominals, back and pectorals.	☒ YES, BUT... You must purchase \$400 in extra accessories to do comparable exercises for legs and pecs.	☒ YES, BUT... Why would you pay \$700 more than HEALTHMAX ?
6 Comfortable bench	☒ YES Padded bench is a full 47" long, 12" wide, and a comfortable 20" high.	☒ NO Padded bench is only 40½" long, making some lying down exercises awkward.	☒ NO Padded 40" bench is short, narrow (only 9" wide), and too high (24") off the ground.
7 Hydraulic cylinder resistance system	☒ YES Adjusts to your personal resistance level with a simple twist of a dial.	☒ NO Uses rubber bands which must be changed to vary resistance level.	☒ NO Uses complicated cord/pulley/mechanical resistance system.
8 Full refund of return freight if unit returned	☒ YES If not satisfied, we will refund your cost, shipping/handling charges, and all return freight!	☒ NO You pay over \$85 to return. It must go by truck to Oregon!	☒ NO You pay about \$65 to return by UPS.
9 Payable in installments	☒ YES 9 easy installments of just \$36.56! (\$49.00 S/H added to first installment.)	☒ YES, BUT... You pay \$39 per month for the next 2 YEARS!	☒ YES, BUT... At 4 payments of \$250, each installment is almost as much as the total cost of a HEALTHMAX !



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SCIENCE & TECHNOLOGY

EDITED BY DAWN STOVER

SPACE

MOON MAPPER

Ranger, Luna, Surveyor, Lunar Orbiter, Apollo...to that illustrious roster of moon-going space vehicles add the name *Clementine*.

Launched by a Titan IIG rocket in late January, the 220-kilogram satellite will fly around Earth twice, then enter a lunar polar orbit on about February 21, thus ending a 20-year-plus hiatus in lunar exploration. *Clementine* will spend two months creating a geological survey map of the moon's surface, then head for the asteroid Geographos, a potato-shaped chunk of rock 3 to 4 kilometers long and 1.5 kilometers wide that is one of the asteroids that cross Earth's orbit (called Apollo-class asteroids).

Astronomers believe such asteroids resulted from collisions inside the main asteroid belt lying between Mars and Jupiter. From a vantage point closer than that of any previous visitor to an Apollo asteroid—as close as 100 kilometers—*Clementine* will take more than 2,000 pictures of Geographos' pockmarked surface.

Officially known as the Deep Space Program Science Experiment, *Clementine* began as the brainchild of the Strategic Defense Initiative Organization, now called the Ballistic Missile Defense Organization, which wanted

an Earth-orbiting satellite to test electronic cameras and other instruments for its antiballistic missile program. Eventually, the mission became a joint project with NASA, and expanded to include scientific observations of the moon and Geographos.

Clementine will carry and test several lightweight components that could help forward NASA's long-term goals of simpler, cheaper planetary missions: A nickel-hydrogen battery with twice the energy density of previous batteries, and the lightest solar cell arrays ever flown in space are included.

So why is the spacecraft named *Clementine*? If you remember the song, the big-footed lass was the daughter of a prospector. *Clementine's* lunar maps may someday help "miners" find useful materials on the moon.—Arthur Fisher



Clementine, with Earth in the background, will spend two months mapping the moon.

CLIMATE

WARMER NIGHTS

Global warming is occurring mostly at night. That's the conclusion of scientists who reviewed temperature records collected at more than 1,000 weather stations over a 40-year period.

The range between daytime and nighttime temperatures is narrowing, according to George Kukla at Columbia University's Lamont-Doherty Earth Observatory, and Thomas Karl at the National Oceanographic and Atmospheric Administration's National Climatic Data Center in Asheville, N.C. They report that daytime high temperatures over the Northern Hemisphere's land masses have increased by only 0.3°F since 1950, while nighttime lows have risen by 1.5°F.

Kukla and Karl warn that current computer models, which do not account for this puzzling trend, may not accurately predict future climates. They suggest that increased cloudiness, possibly caused by air pollution, may hold down daytime temperatures.

WINTER

JAMES GRAY FOR NASA / COURTESY OF THE PLANETARY SOCIETY



U.S. AIR FORCE

The OC-135B will make unarmed observation flights to uphold the Treaty on Open Skies.

AVIATION

SKY PATROL

Foreign reconnaissance aircraft will soon begin photographing sensitive military bases around the world—by invitation. These unarmed flights will start once 20 of 27 signatory countries have ratified the Treaty on Open Skies, which could happen as early as this year.

Signed in 1992 by the members of NATO and the former Warsaw Pact, the treaty is designed to improve international stability by promoting openness about military activities. Observation flights will be conducted on aircraft provided either by the observing country or the nation being observed, and annual flight quotas will be scaled to the size of each country. The two largest participants, the United States and the group-state of Russia-Belarus, are each allotted 42 flights per year.

The first U.S. Open Skies aircraft is ready to go. Designated an OC-135B, it's a modified weather craft, which itself was a modified KC-135B aerial tanker. Four film cameras aimed through optical-quality glass windows in the rear fuselage comprise the heart of the airplane's imaging system. Obliquely mounted cameras record images to the left and right of a vertically mounted unit; this trio operates at altitudes from 3,300 to 8,600 feet above ground level. A fourth unit, a single panoramic camera, is used at higher altitudes.

The OC-135B can carry 38 people, including the flight and maintenance crew, observing-nation representatives, and members of the U.S. On-Site Inspection Agency. A branch of the Pentagon, the OSIA will provide sensor operators and linguists during missions. *Nothing* is off-limits to Open Skies flights. Top-secret military facilities will be scrutinized from the air—which is precisely the treaty's intent. Copies of images made during any flight will be available to all the member nations.—*Stuart F. Brown*

FOOD SCIENCE

IN THE PINK

Consumers shun gray prime rib and dingy ground beef. So a method to keep fresh beef looking pink longer could save \$1 billion worth of meat annually.

Discoloration does not necessarily mean that food has spoiled. Meat naturally turns gray or brown in the presence of oxygen, which reacts with the meat's proteins. To delay this reaction, researchers at Colorado State University add vitamin E—an antioxidant—to cattle feed. When the cattle are slaughtered, the vitamin remains in the tissues and limits discoloration.

"Typically, ten to fifteen percent of all beef becomes off-colored before it reaches the end of its labeled shelf life," explains Colorado State researcher Brad Morgan. "We're not trying to extend the shelf life of beef products—just save that amount that turns gray early."

The technique could lower the price of your favorite steak or roast, because less beef will be thrown away by retailers. And because the vitamin E remains in the meat, it may help supplement diets low in the nutrient.—*Judith Anne Gunther*

DINOSAURS

TYRANNOSAURUS TURKEYS

It's a science tidbit that is being drummed into the heads of science students around the world: Every cell in your body contains your complete genetic blueprint. Fine. So if you could find just one dinosaur cell, would you have the entire genetic blueprint for a dinosaur?

Maybe. Montana State University paleontologist Jack Horner, famous for his work on the social lives of duck-billed dinosaurs, has unearthed the fossilized bones of a *Tyrannosaurus rex* and has found what appear to be fossilized blood cells in the bone's marrow. If they are cells, and if the nucleus is intact, there's a good chance that Horner will be able to extract at least part of the dinosaur's genetic code.

Horner could never start his own Jurassic Park by cloning a living dinosaur. Instead, he hopes the research will provide insight into a problem that divides modern paleontologists: Did dinosaurs leave behind any relatives that are alive today? Some scientists believe that birds and crocodiles may be distant relatives of dinosaurs. "You eat a dinosaur every Thanksgiving," Horner says.—*Sandy Fritz*

SOLAR ENERGY

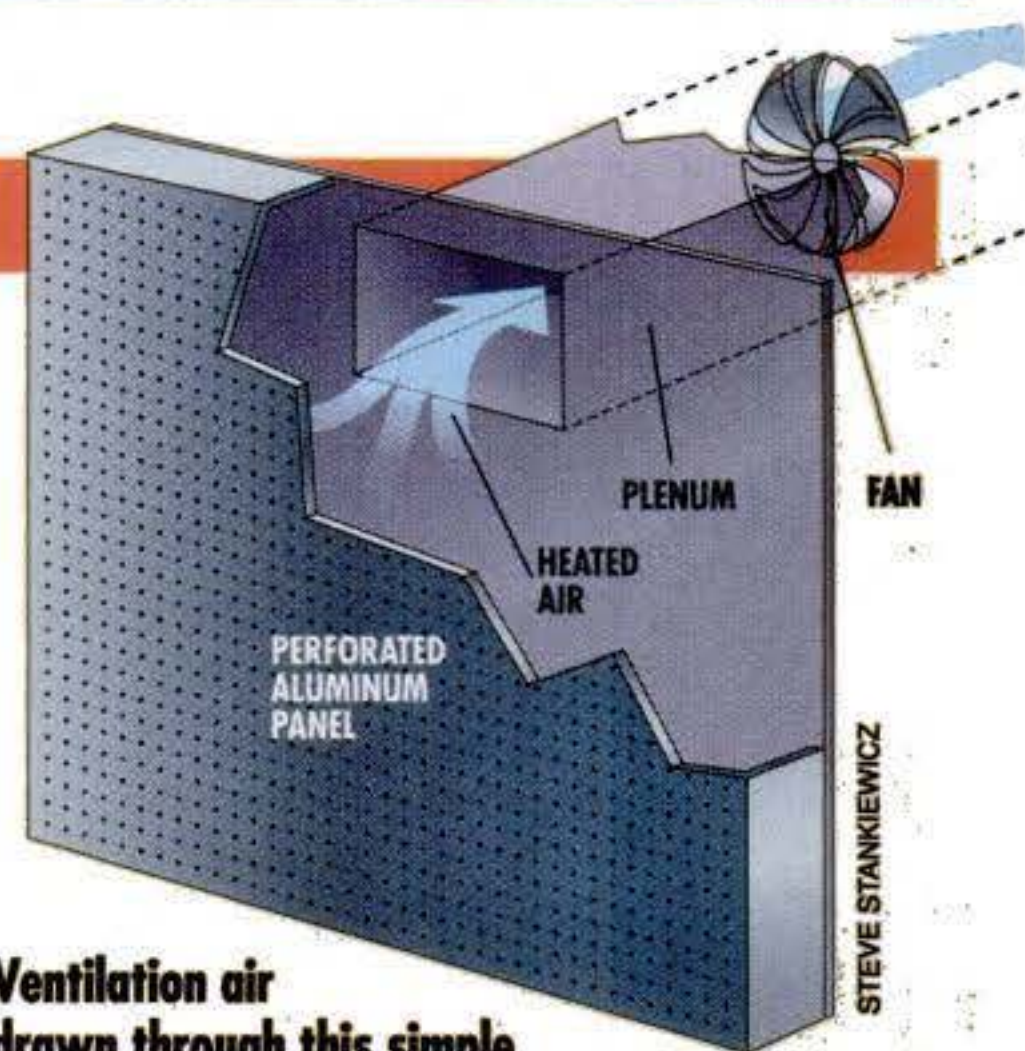
BLACK HOLES

Un glazed transpired collector is a fancy name for a black, perforated aluminum panel. Attached to the sunny side of a building, the panel can preheat ventilation air at efficiencies of up to 75 percent—making it one of the best-performing solar heating systems ever designed, say its developers.

By comparison, common glass-covered collectors such as those found in solar heaters are only 35 to 40 percent efficient. One reason for this lower efficiency is because glass reflects some incoming energy, says Chuck Kutscher of the National Renewable Energy Laboratory in Golden, Colo., which has fine-tuned the panel technology.

A fan draws air through $\frac{1}{32}$ -inch-diameter perforations in the panel, warming the air by 18 to 27 °F before it enters the building's ventilation system. Computer modeling and wind-tunnel experiments helped researchers choose the best hole size and spacing, plenum depth, and header shape to ensure uniform airflow—and maximum efficiency.

The panels cost about \$10 per square foot,



Ventilation air drawn through this simple solar collector can be preheated by 18 to 27 °F.

making them practical for large commercial buildings in colder climates. Toronto-based Conserv, which is commercializing the system, has installed it on two buildings in Canada, belonging to GM and Ford, and a third building in New York. Another installation is planned for the Fort Carson Army Base near Colorado Springs, Colo.

In addition to preheating ventilation air, the panels could also be used for drying grain, regenerating desiccant materials, and radiant cooling. Researchers are exploring other potential solar-collector materials, such as plastics.

—*Mariette DiChristina*

MEDICINE

SPECIAL DELIVERY

Only a small fraction of eye medicine given by eye drops or injection ever reaches its target, says physicist Ran Zeimer of Johns Hopkins University. For medication aimed at the retina, Zeimer's solution is to wrap the drug in a tiny liposome, a heat-sensitive packet of fat that is injected into the bloodstream. Zeimer uses a special microscope to select the area of the retina to be treated, then zaps it with a brief burst of infrared laser light that heats blood vessels a few degrees above body temperature. The heat makes the liposome release the drug in the exact area to be treated.

Among the conditions potentially treatable by the liposome-and-laser combination is macular degeneration, an overgrowth of blood vessels in the retina that can cause blindness. Retinal inflammation and infections are also potential targets, Zeimer says. —Edward Edelson

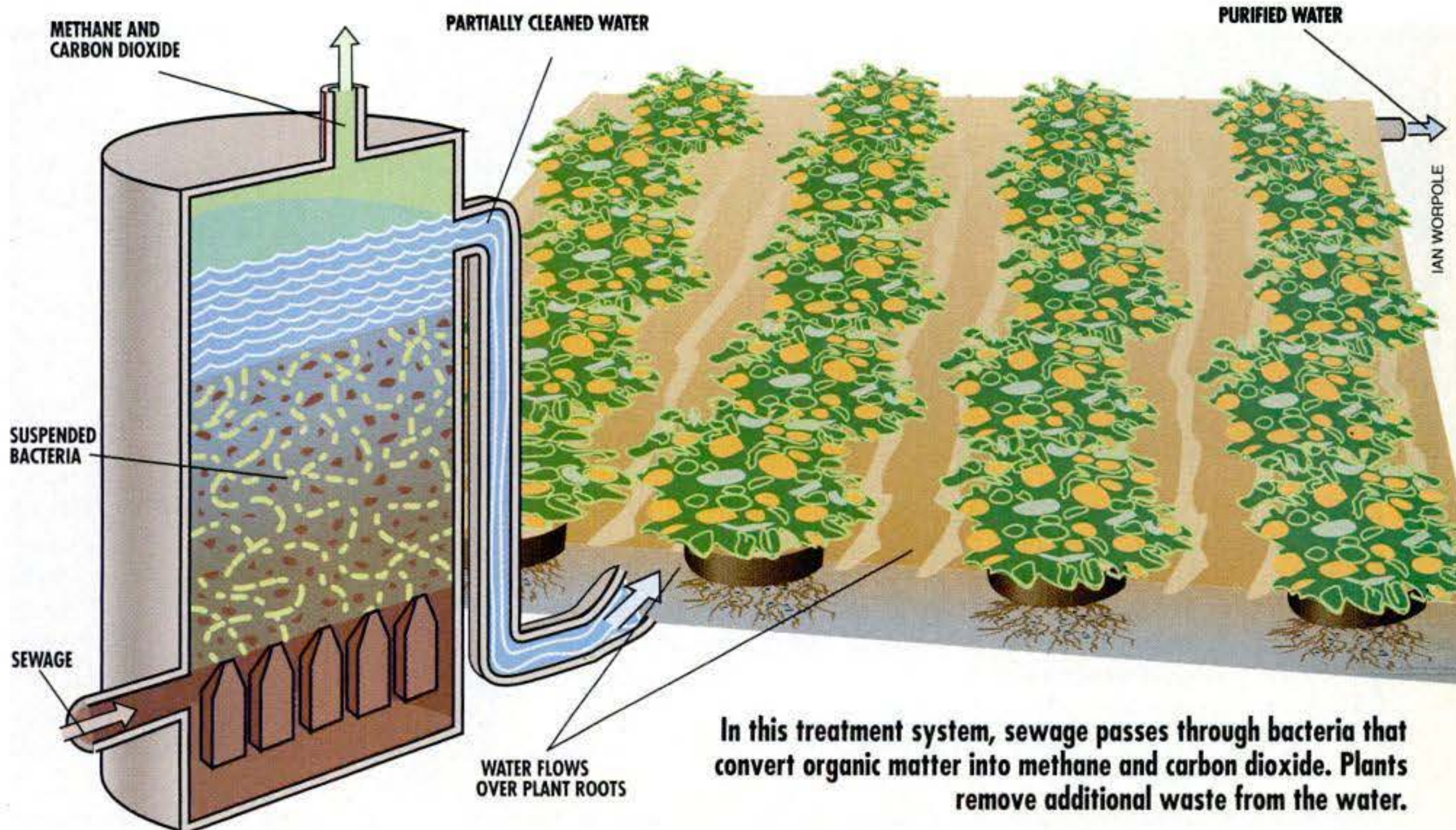
ENVIRONMENT

SEWAGE SOLUTION

Can you imagine a chemical-free sewage-treatment facility that cleans water better than current municipal treatment systems, generates methane gas, and doubles as a plant nursery? William Jewell and his colleagues at Cornell University recently tested a system that does all that, using only bacteria and plants.

Waste first passes through a filter in which anaerobic bacteria cling to tiny particles of diatomaceous earth. This filter provides 10,000 times more surface area than comparably sized rock-trickling filters used in contemporary treatment facilities. The bacteria convert organic matter into carbon dioxide and methane, and the methane can be collected and sold.

In the second stage of the treatment process,



ASTRONOMY

WHEN VENUS WAS WET

Although scientists call them twin planets, Earth and Venus have a glaring difference: Whereas our lush planet is dominated by vast oceans, nearby Venus is a hot, dry wasteland.

But it wasn't always that way: Data sent back from the Pioneer Venus Orbiter suggests that some 3.5 billion years ago Earth's neighbor was covered with water as much as 200 feet deep.

The ocean on young Venus may have lasted a billion years, says Thomas M. Donahue, who was chief scientist for the Pioneer Venus Orbiter mission and is a professor of planetary science at the University of Michigan. That's long enough to support the evolution of life. But the ocean is believed to have vaporized after the sun heated up and started a runaway greenhouse effect on Venus.

As the ocean evaporated, solar ultraviolet radiation split water molecules into hydrogen and oxygen. Much of the lightweight hydrogen was

blown off into space, but its heavier isotope deuterium stayed behind in the atmosphere. Some 15 years ago, at the beginning of the Pioneer Venus Orbiter mission, the ratio of deuterium to hydrogen was found to be 150 times greater on Venus than at any other place in the solar system. That led scientists to theorize that the planet once had at least 150 times more water—an ocean about six feet deep—than it does now.

But a reexamination of the data, coupled with details sent back by the now-defunct orbiter during its final descent, has prompted scientists to change their estimate. According to Donahue, it now seems that deuterium can escape more easily than first believed, and that the amount of hydrogen in Venus's atmosphere was greatly underestimated. This means the planet had about 35 times more water 3.5 billion years ago than was originally estimated.

There are still skeptics who believe that our neighbor in space was dry from the start. But the Pioneer data makes it more plausible that Venus, with a size and chemical makeup similar to Earth's, once shared its wet climate.

—Naomi Freundlich

neering, Jewell and his colleagues built a pilot plant in Ithaca, N.Y., that ran for four years and treated up to 10,000 gallons per day (the amount of waste generated by about 100 people). From the results, Jewell concludes: "In relation to other plant-based systems, it looks like ours can get almost ten times better effluent quality." He hopes that "water parks" will one day replace conventional sewage-treatment facilities. —Mike May

MARS

SPACE
CAPSULE

BY MICHAEL CARROLL

Future explorers on the planet Mars may want to bring along a portable CD-ROM player.

Thanks to the efforts of The Planetary Society, the Time Warner Interactive Group, and Russia's Institute for Space Research, a compact disc will be waiting for them on the surface of the red planet.

"This is, in a way, the first time capsule sent to another planet," says project director Jon Lomberg of The Planetary Society. "It's a tapestry of text, image, and sound representing what people from around the world have thought and said about Mars."

With a capacity of 180 megabytes, the Visions of Mars disc con-

tains views, songs, paintings, and even comic images of Mars. "We hope the contents of the disc will be taken as a representative selection," says Lomberg.

Identical copies of the disc will fly aboard twin Russian Mars landers that will touch down on the martian surface in 1995. A plaque on the exterior of each spacecraft has instructions, printed in five languages, for playing the CDs with a laser.

The spacecraft will also carry a microdot, a piece of film with miniaturized instructions, with further technical information for the CD playback. The microdot is on a silicon chip that is actually a sophisticated scientific experiment. The chip carries an array of passive detectors, designed by the Micro Devices Lab of NASA's Jet Propulsion Laboratory, which will serve as a long-duration Mars exposure experiment.

"This array will ride along on the chip," says Lomberg, "and then sit on the martian surface for the fifty, hundred, or two hundred years it

AN ALBUM OF GREATEST HITS

Visions of Mars begins with greetings from four people who have played key roles in exploring or imagining Mars: Viachislav Linkin, the Russian scientist in charge of the Mars lander program; astronomer Carl Sagan; author Arthur C. Clarke; and Judith Merril, a science-fiction writer, historian, and editor.

An hour-long audio section follows, including a portion of the 1938 "War of the Worlds" radio broadcast, a rare interview in which H. G. Wells and Orson Welles discuss the broadcast, and a documentary program in which science-fiction writers like Robert Heinlein and Ray Bradbury, and "Star Trek" creator Gene Roddenberry, give their reactions to the first Viking landing on Mars.

The Mars disc also features a portfolio of astronomical art and science-fiction paintings, as well as pop-culture images from comic books, cartoons, and movies showing various ways that Mars and martians have been portrayed. Artists from all over the world are represented.

The disc includes more than 70 short stories and novels. Among those selected are *Princess of Mars* by Edgar Rice Burroughs, *The Sands of Mars* by Arthur C. Clarke, and Ray Bradbury's *The Martian Chronicles*. Appendices give an introduction to each story, outlining each author's background, what was happening in science fiction at the time of the writing, and how much the story reflected the then-current scientific thinking about Mars.—M. C.



Among the classic paintings on the Visions of Mars disc are Chesley Bonestell's "Mars from Phobos" (left) and Frank Kelly Freas' "Little Green Man" (below), which first appeared on the cover of a sci-fi novel in 1954.



tains dozens of short stories and several full novels from celebrated writers. "Nearly all the great science fiction authors are included," says Lomberg, "as well as people that you don't normally associate with science fiction, like Bertrand Russell." The disc also contains radio inter-

views, songs, paintings, and even comic images of Mars. "We hope the contents of the disc will be taken as a representative selection," says Lomberg. Identical copies of the disc will fly aboard twin Russian Mars landers that will touch down on the martian surface in 1995. A plaque on the exterior of each spacecraft has instructions, printed in five languages, for playing the CDs with a laser. The spacecraft will also carry a microdot, a piece of film with miniaturized instructions, with further technical information for the CD playback. The microdot is on a silicon chip that is actually a sophisticated scientific experiment. The chip carries an array of passive detectors, designed by the Micro Devices Lab of NASA's Jet Propulsion Laboratory, which will serve as a long-duration Mars exposure experiment. "This array will ride along on the chip," says Lomberg, "and then sit on the martian surface for the fifty, hundred, or two hundred years it

materials are best for structures there. Optical fibers, semiconductors, and other items important to modern technology will be tested.

One piece of miniaturized equipment on the chip is a tiny laser diode made of aluminum gallium arsenide, the type of laser required to read the CD-ROM aboard the spacecraft. "On the *Voyager*, we enclosed a cartridge and stylus to help play a record," Lomberg explains. "In a sense, we're doing the same thing here. We're specifying the types of lasers, computers, and software necessary to read the CD."

"We also list the 1990s computers and CD-ROM players that can be used, in case [future Mars explorers] find one lying around at the Smithsonian. We imagine if they're smart enough to get to Mars, they'll be good enough engineers to figure out a laser system."

Time Warner Interactive Group, the company responsible for manufacturing the Mars-bound disc, plans to sell replicas beginning later this year. All royalties will go to The Planetary Society's Mars Fund. "When people purchase replicas of the CD to find out what has been sent," says Lomberg, "the royalties from those sales go directly back into the exploration of Mars, and in a way make it a self-fulfilling prophecy." **ES**

To treat symptomatic benign enlarged prostate: Finally, a medicine that can shrink the prostate.

PROSCAR.[®] (FINASTERIDE)

Until recently, there wasn't a medicine that could help the condition known as symptomatic benign prostate enlargement or BPH. But now there is PROSCAR, the first oral prescription medicine that can shrink an enlarged prostate.

However, it is important to know the following: PROSCAR doesn't work for everyone. Even though your prostate may shrink, you may not see an improvement in urinary flow or symptoms. And you may need to take PROSCAR for 6 months or more to see whether it helps you.

How PROSCAR can shrink an enlarged prostate.

As a man ages, a key hormone can help cause the prostate to grow. PROSCAR actually blocks the production of this hormone, so it helps shrink the prostate to a smaller size in many men. As a result, some men treated with PROSCAR experience an increased urinary flow and an improvement in urinary symptoms.

Why you should see your doctor soon.

Your doctor has several options for the treatment of symptomatic BPH: watchful waiting (monitor-

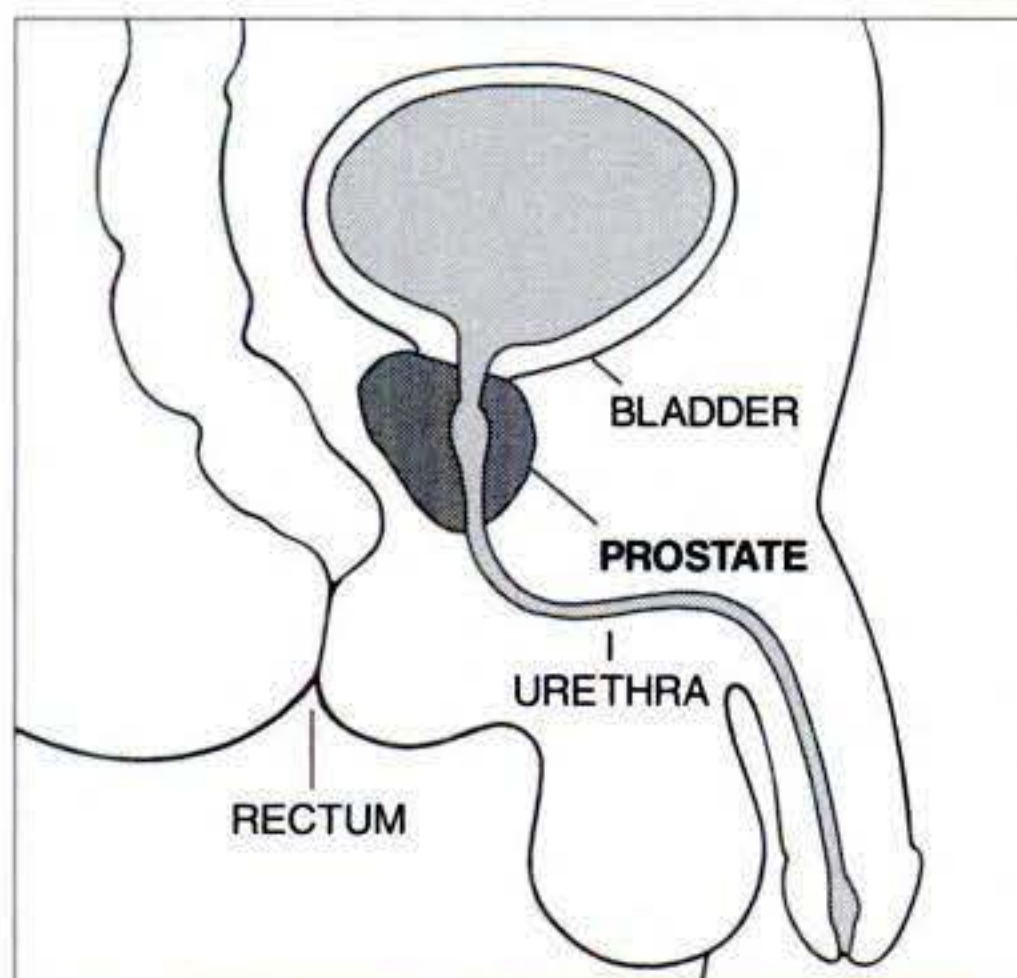


ing the condition with regular checkups), medication, or surgery. It's important to see your doctor because the problem doesn't usually get better by itself. In many cases, the prostate continues to enlarge and the symptoms may get worse. So if your urinary symptoms are bothering you, have your family doctor or a urologist assess your condition and ask if PROSCAR is an appropriate treatment for you.

It is also important to have regular checkups. *While benign prostate enlargement is not cancer and does not lead to cancer, the two conditions can exist at the same time.*

Remember, only a doctor can evaluate your symptoms and their possible causes. So, if your urinary symptoms are bothering you, don't wait any longer. You may find that your enlarged prostate can be made into a smaller problem.

For more information about prostate enlargement and PROSCAR, call 1-800-635-4452 today.



The prostate surrounds part of the urethra, the tube that carries urine from the bladder. As the prostate enlarges, it can squeeze the urethra and cause urinary problems.

TABLETS
PROSCAR[®] 5mg
(FINASTERIDE)



PATIENT INFORMATION ABOUT PROSCAR® (Prah-s-car)

Generic name: finasteride (fin-AS-tur-eyed)

PROSCAR is for the treatment of symptomatic benign prostatic hyperplasia and for use by men only.

Your doctor may prescribe PROSCAR if you have a medical condition called benign prostatic hyperplasia or BPH. This occurs only in men.

Please read this information, as well as the leaflet which accompanies your medication, before you start taking PROSCAR. Also, read the leaflet each time you renew your prescription, just in case anything has changed. Remember, this leaflet does not take the place of careful discussions with your doctor. You and your doctor should discuss PROSCAR when you start taking your medication and at regular checkups.

What is BPH?

BPH is an enlargement of the prostate gland. After age 50, most men develop enlarged prostates. The prostate is located below the bladder. As the prostate enlarges, it may slowly restrict the flow of urine. This can lead to symptoms such as:

- a weak or interrupted urinary stream
- a feeling that you cannot empty your bladder completely
- a feeling of delay or hesitation when you start to urinate
- a need to urinate often, especially at night
- a feeling that you must urinate right away.

Treatment options for BPH

There are three main treatment options for BPH:

• **Program of monitoring or "Watchful Waiting".** If a man has an enlarged prostate gland and no symptoms or if his symptoms do not bother him, he and his doctor may decide on a program of monitoring which would include regular checkups, instead of medication or surgery.

• **Medication.** Your doctor may prescribe PROSCAR for BPH. See "What PROSCAR does" below.

• **Surgery.** Some patients may need surgery. Your doctor can describe several different surgical procedures for BPH. Which procedure is best depends on your symptoms and medical condition.

What PROSCAR does

PROSCAR lowers levels of a key hormone called DHT (dihydrotestosterone), which is a major cause of prostate growth. Lowering DHT leads to shrinkage of the enlarged prostate gland in most men. This can lead to gradual improvement in urine flow and symptoms over the next several months. However, since each case of BPH is different, you should know that:

- Even though the prostate shrinks, you may NOT see an improvement in urine flow or symptoms.
- You may need to take PROSCAR for six (6) months or more to see whether it helps you.
- Even though you take PROSCAR and it may help you, it is not known whether PROSCAR reduces the need for surgery.

What you need to know while taking PROSCAR

• **You must see your doctor regularly.** While taking PROSCAR, you must have regular checkups. Follow your doctor's advice about when to have these checkups.

• **About side effects.** Like all prescription drugs, PROSCAR may cause side effects. Side effects due to PROSCAR may include impotence (or inability to have an erection) and less desire for sex. Each of these side effects occurred in less than 4% of patients in clinical studies. In some cases side effects went away while the patient continued to take PROSCAR.

Some men taking PROSCAR® (Finasteride) may have a decrease in the amount of semen released during sex. This decrease does not appear to interfere with normal sexual function.

You should discuss side effects with your doctor before taking PROSCAR and anytime you think you are having a side effect.

• **Checking for prostate cancer.** Your doctor has prescribed PROSCAR for symptomatic BPH and not for cancer—but a man can have BPH and prostate cancer at the same time. Doctors usually recommend that men be checked for prostate cancer once a year when they turn 50 (or 40 if a family member has had prostate cancer). These checks should continue while you take PROSCAR. PROSCAR is not a treatment for prostate cancer.

• **About prostate specific antigen (PSA).** Your doctor may have done a blood test called PSA. PROSCAR can alter PSA values. For more information, talk to your doctor.

• A warning about PROSCAR and pregnancy.

PROSCAR is for use by MEN only.

PROSCAR is generally well tolerated in men. However, women who are pregnant, or women who could become pregnant, should avoid the active ingredient in PROSCAR.

If the active ingredient is absorbed by a woman who is pregnant with a male baby, it may cause the male baby to be born with abnormalities of the sex organs. Therefore, any woman who is pregnant or who could become pregnant must not come into direct contact with the active ingredient in PROSCAR.

Two of the ways in which a woman might absorb the active ingredient in PROSCAR are:

Sexual contact. Your semen may contain a small amount of the active ingredient of the drug. If your partner is pregnant, or if you and your partner decide to have a baby, you must stop taking PROSCAR and talk to your doctor. If your partner could become pregnant, proper use of a condom can reduce the risk of exposing her to your semen (discuss this further with your doctor).

Handling broken tablets. Women who are pregnant or who could become pregnant must not handle broken tablets of PROSCAR.

PROSCAR tablets are coated to prevent contact with the active ingredient during normal handling. If this coating is broken, the tablets should not be handled by women who are pregnant or who could become pregnant.

If a woman who is pregnant comes into contact with the active ingredient in PROSCAR, a doctor should be consulted. Remember, these warnings apply only if the woman exposed to PROSCAR is pregnant or could become pregnant.

How to take PROSCAR

Follow your doctor's advice about how to take PROSCAR. You must take it every day. You may take it with or between meals. To avoid forgetting to take PROSCAR, it may be helpful to take it the same time every day.

Do not share PROSCAR with anyone else; it was prescribed only for you.

Keep PROSCAR and all medicines out of the reach of children.

FOR MORE INFORMATION ABOUT PROSCAR AND BPH, TALK WITH YOUR DOCTOR. IN ADDITION, TALK TO YOUR PHARMACIST OR OTHER HEALTH CARE PROVIDER.



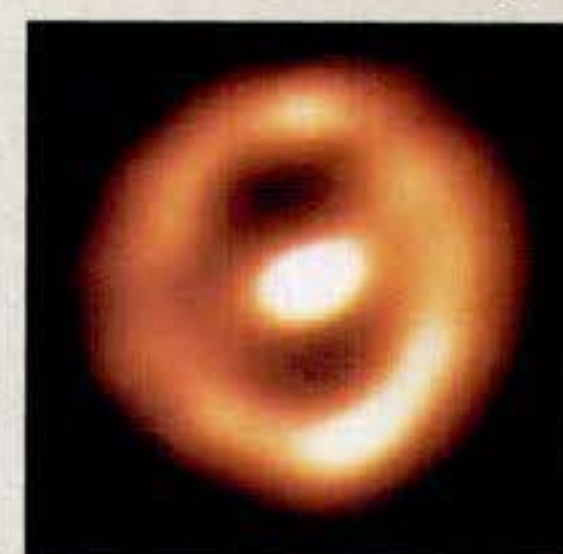
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ASTRONOMY

No Smoking In Space

It looks like a no-smoking sign, but it's actually a rapidly expanding gas bubble around an old star that went nova, or exploded. The Hubble Space Telescope captured the image in ultraviolet light just 467 days after this event, giving astronomers the earliest look ever at such stellar blasts. It will be another five years before ground-based telescopes can see the nova. By then, the gas shell will be deformed and chemically contaminated by other material around the star.

The "bar" inside the ring might mark the



orbital path of the two stars in the binary system. Or it might be twin jets of gas ejected from the exploding star.—M. D.

NANOTECHNOLOGY

THE LITTLE ENGINE THAT COULD

Much smaller than HO-gauge, a new steam engine from Sandia National Laboratories in Albuquerque, N.M., promises to be an important source of power for tomorrow's micromachines—devices with microscopic gears.

"Until now, such machines have been powered by electrostatic actuators," explains Sandia microelectronics expert Jeff Sniegowski, "but those don't provide enough power to do useful work. This steam engine produces 100 times as much power as those actuators."

Small enough to fit on a computer chip, Sniegowski's engine has a piston that is just six microns wide and two microns tall. It slides in and out of a "cylinder"—a hollow space within a silicon cover, with a tiny drop of water inside. When a burst of electric current is applied, the droplet flashes into steam. The pressure of the steam pushes the piston out. At the end of its travel, a spring forces the piston back in, and the engine fires again.

"We have tested the engine at rates of several cycles per second for hours," says Sniegowski, "and it looks very reliable. Its first use may be in a miniature push-pull tool that will precisely align optical fibers for communications."—Jonathan D. Beard

SOLAR ENERGY

SUNLIT SEMINARY

Ambridge, Pa., a town scarred environmentally and economically by defunct steel mills, is now showcasing a benign technology. In a project representing one of the most extensive uses of photovoltaics in a nonresidential building, a seminary will be lit during the day almost entirely by energy from solar panels.

The 25,000-square-foot building, an administrative office for Trinity Episcopal School for the Ministry, has 900 square feet of photovoltaic panels—about nine kilowatts' worth—on its roof. During the day, electrical current flows directly from the panels to highly efficient fluorescent lights with electronic ballasts. During cloudy weather, batteries contribute power. At night, the batteries recharge using local utility power, provided at off-peak prices.

"What's unusual about this project is that we operate the lights from direct current instead of alternating current," explains project manager Alan Hathaway. "The reason is that photovoltaics

inherently generate direct current." Most electrical products require AC, of course, so photovoltaic systems usually have an inverter to change the current from DC to AC. But this project uses fixtures with electronic ballasts that can handle DC.

"By eliminating the inverter, we can cut one-third to two-fifths of the cost of the photovoltaic system," Hathaway claims. The Trinity School installation will cost about \$100,000, and probably won't pay for itself until the year 2013. But Hathaway calculates that, with anticipated lower future prices for photovoltaics and without the costs of equipment used to scientifically monitor the system, such a setup should pay for itself in less than 15 years—making photovoltaics feasible for commercial buildings. "People wrote off solar power because it was so darn expensive," he says. "But if we combine solar with electronically ballasted lighting, it's a whole new ball game."

The seminary project is jointly funded by Mobil Solar, Osram Sylvania, the Pennsylvania Energy Office, the U.S. Department of Energy, and Duquesne Power & Light.—J. A. G.

AVIATION

SPRINKLERS COULD SAVE LIVES

Until recently, says a soot-covered Tim Marker, aviation safety researchers focused on preventing accidents—not on saving lives when airline disasters occur.

That's one reason commercial airliners don't typically feature sprinklers, the aerospace engineer explains, as he strolls between the charred fuselages of two former passenger jets inside the Federal Aviation Administration's fire safety lab near Atlantic City, N.J. Another reason is that water is heavy, and the cost of carrying enough to douse a whole jet cabin is prohibitive.

But Marker and his colleagues have devised a solution: a "zoned" sprinkler system that uses heat and smoke detectors to sense the locations of fires, and then sprays a mist only in those sections of the plane. In tests, the system consumed a mere eight gallons of water and kept a simulated jet-fuel fire at bay for two to three minutes. In a crash, Marker says, this would give most passengers time to escape.—Robert Langreth **PS**

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AUTOMOTIVE

EDITED BY DAN McCOSH

TOKYO MOTOR SHOW

SMALL, BOXY, AND FUN

Japan's auto industry is slumping, with stagnant sales at home and a shrinking market share abroad. This dampened the spirit of the 1993 Tokyo Motor Show. Concept cars seemed toned down, styling less inspired, and many "new" safety and environmental technologies had been seen before.

Despite the gloom, designers let their imaginations loose in one area: sport utility vehicles (SUVs). New concept and prototype cars revealed an array of innovative SUVs headed for the market. "These vehicles are very popular in Japan right now," said Masahiro Toi, Nissan product manager for the Mistral, "so automakers are responding."



Square shapes allow more interior room for small cars. Daihatsu's Ultra Mini (left) investigates tiny square shapes, as does Toyota's Raum-II (below).



Suzuki and Isuzu, especially, are redefining the very meaning of SUV. Suzuki's X90 is a cross between a sports car and an off-roader. Built on the Escudo platform, the two-seat 4x4 features a T-bar roof. Chances are it will hit the U.S. market in 1993. With two concept models, Isuzu convincingly demonstrated that sleek, aerodynamic styling can be applied to SUVs. VehiCross, a compact four-seater, resembles an updated incarnation of a dune buggy. The XU-1, intended for in-town and off-road driving, features the size and outline of a station wag-

on, but with high ground clearance and four-wheel drive.

If aerodynamic styling is coming to SUVs, however, other cars seem headed in the opposite direction. Designers believe squarish outlines are coming back because they allow more interior space in the smaller cars now required by tightening emissions standards.

"When you try to make the interior as roomy as possible, this is what you get," said Yoshihiko Nakagawa, a Daihatsu project manager displaying his Ultra Mini concept car. While the Ultra Mini, as its name implies, is intended for Japan's minicar class, other companies are using the same principles for standard cars. Toyota's Raum-II concept car is a full-size family sedan with boxy lines so as to maximize interior space.

Boxy cars are already on the market: The Wagon R from Suzuki and Mitsubishi's Minica Toppo Q3 are two recently released examples. In contrast to previous minicars, which resemble shrunken sedans, these cars look more like shrunken UPS delivery trucks.

Sitting in the back seat of the Minica Toppo Q3, I found the designers' claims to be true; it was less cramped and had been easier to enter than other minicars. Just as with shoes, some car buyers may be willing to ignore what their cars look like if they are a comfortable fit.—Dennis Normile



Isuzu's "multipurpose urban utility vehicle"—the XU-1 (above)—has gull-wing doors. Nissan explores the SUV market with the Mistral (right).

SAFETY

IT'S IN THE BAG

Federal legislation says that all cars sold by 1997 must be fitted with dual air bags, but that still leaves millions of older vehicles plying the roads without even one of these lifesaving devices.

Now, owners of certain cars made between 1987 and 1994 will be able to swap their old steering wheels for new ones that include a driver's side air bag. Breed Technologies in Lakeland, Fla., will offer the system through

new and used car dealers at a cost of about \$900, including installation.

The Breed air bag differs from those installed as original equipment in one major respect: While most cars in this country use electromechanical sensors that close a circuit on impact to deploy the bag, the Breed air bag features a mechanical system; the shock of impact travels up the steering column to trigger the air bag. The Breed air bag inflates to about two-thirds the size of factory-fit air bags and must be used with shoulder and lap belts.

Retrofit air bags for GM vehicles—including Chevy pickups, vans, and smaller cars, as well as some Buicks, Oldsmobiles, and Pontiacs—will be the first available. Eventually, the system will be available for about 30 models of GM, Chrysler, Ford, Toyota, and Honda vehicles.—Sandy Fritz

PREVIEW DRIVE

PORSCHE'S 911: MORE FOR LESS

The 1995 Porsche 911 Carrera coupe has given the German automaker's classic design a complete overhaul. In fact, more engineering and design changes were made to this rear-engine, rear-drive 911 than to all previous 911s combined.

The 911 Carrera carves some of the bulges from the previous Carreras. There's no chrome on this new, sleeker body. Its bumpers are fully integrated, as are its laid-back projector beam headlamps and full-width taillamps. The 911 also features dual air bags and a fifth-generation antilock braking system.

At the heart of the Carrera is its trademark air-cooled 3.6-liter flat-six engine, fitted with dual exhausts for the first time and with the latest electronic engine controls, fuel-injection control, and new hydraulic valve lash adjusters. Output is up from 247 to 270 horsepower at 6,100 rpm, and the torque increases from 228 to 243 lb.-ft. at 5,000 rpm. A new six-speed manual or Porsche's automatic computer-controlled transmission is available. Porsche says

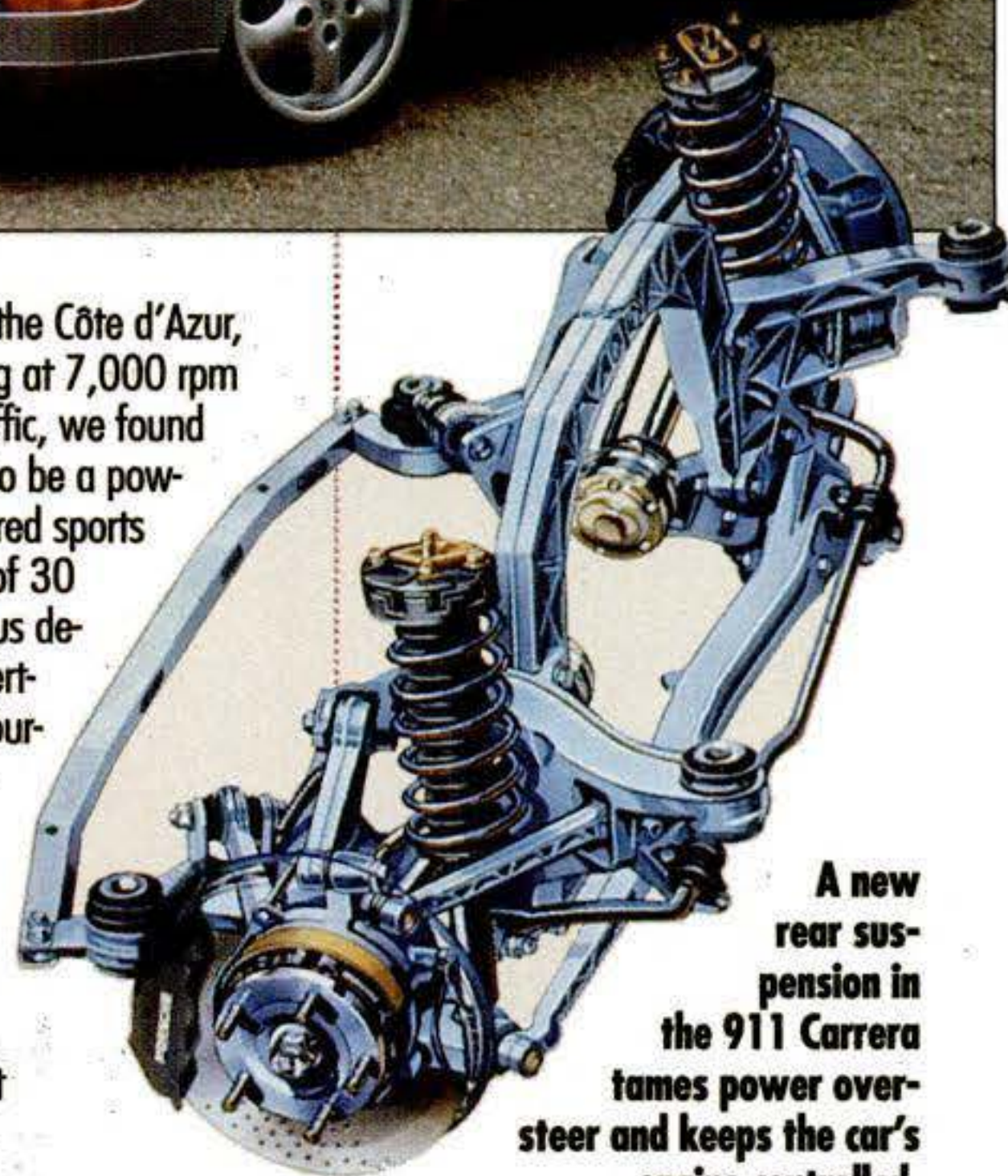
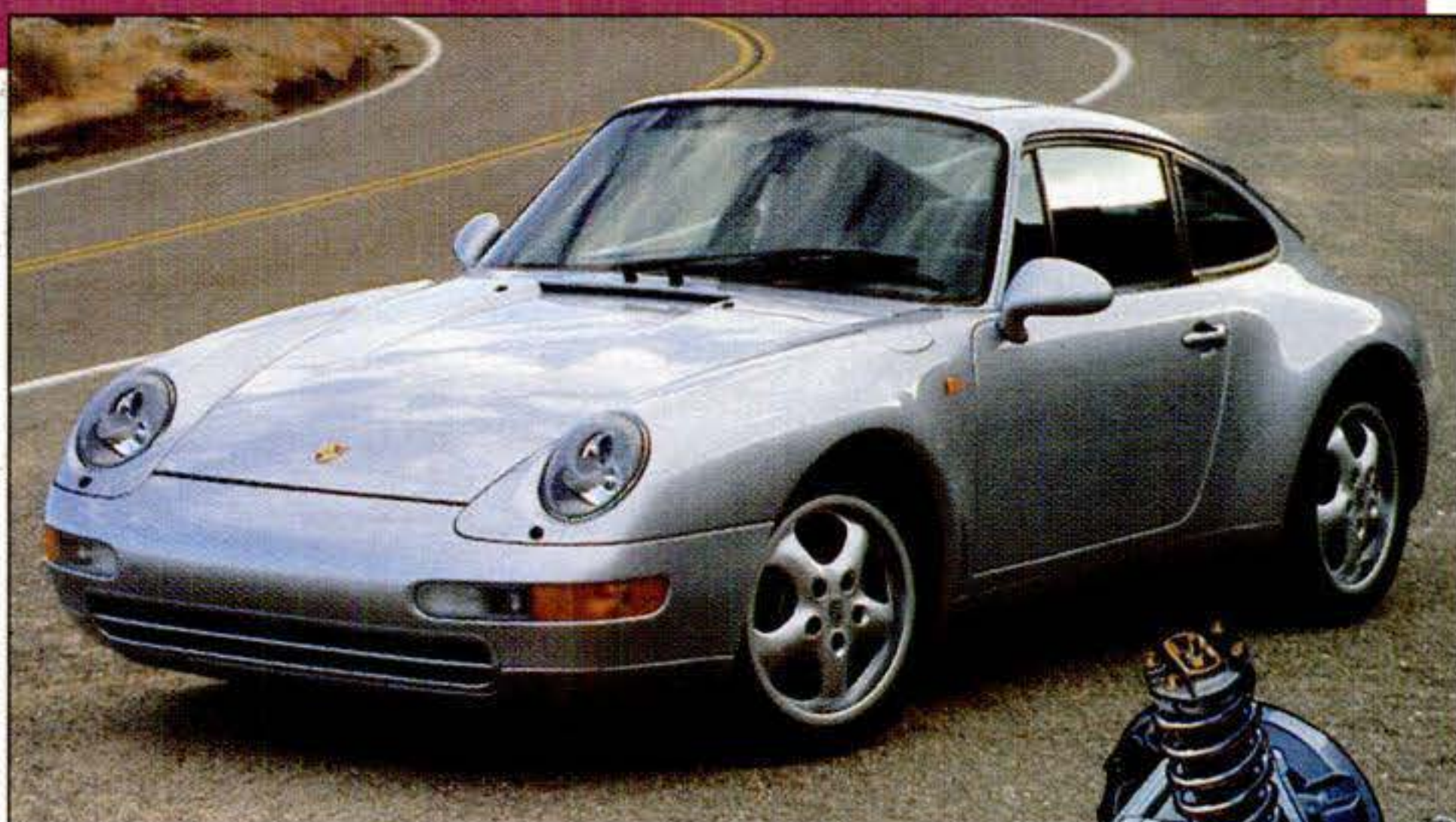
the car accelerates from 0-60 mph in 5.4 seconds and tops out at just under 170 mph.

The biggest improvement to the car, however, is its rear suspension, with a huge, cast aluminum sub-frame supporting transverse aluminum A-arms, coil-over-shock units, and an 18mm antiroll bar (a 20mm bar is optional). Coupled with 9- by 16-inch alloy wheels and monster 245/45ZR-16 tires, the rear suspension system (called LSA for light, strong, and agile) keeps the engine's power under tighter control than any previous 911. Power oversteer, a 911 foible for decades, seems to have been conquered. The front suspension—MacPherson struts with lower arms made of an alloy, plus an antiroll bar and 205/55ZR-16 tires—blends well with a rack-and-pinion power steering system that is more accurate than ever before.

In more than 300 kilometers of

mixed driving on the Côte d'Azur, whether upshifting at 7,000 rpm or negotiating traffic, we found the 911 Carrera to be a powerful, well-mannered sports car, the pinnacle of 30 years of continuous development. Convertible, Turbo, and four-wheel-drive versions will follow the coupe; the convertible should become available this spring. Prices start at \$59,500.

—Jim McCraw



A new rear suspension in the 911 Carrera tames power oversteer and keeps the car's engine controlled.

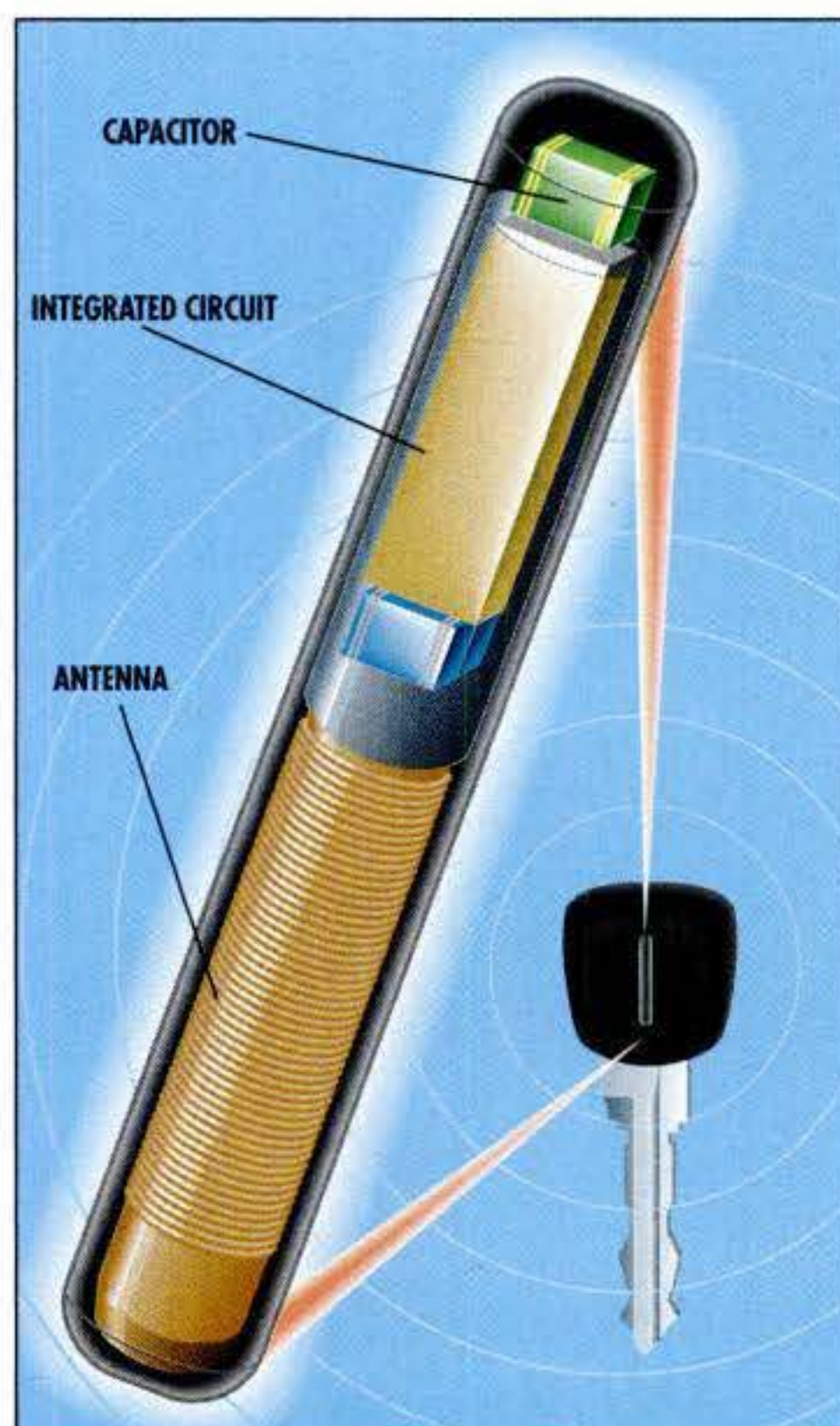
SECURITY

RECOGNITION IN THE HEAD OF A KEY

It seems that as auto-theft prevention systems increase in sophistication, so do the thieves. Now, Texas Instruments has developed a radio frequency identification system that may help foil would-be hijackers. Unlike magnetic systems, TI's system doesn't rely on alloy contacts in the ignition lock that could increase the possibility of mechanical failures.

Called SafeGuard, the self-arming security system has potentially millions of combinations, or identification codes, and controls access to your car's computer or fuel system. Ford's Electronics division is offering the technology as an option on the European Escort and Fiesta; it may be introduced in the United States as early as 1995.

SafeGuard is completely transparent to the driver. As the key is turned in the ignition, a radio frequency read-



A transponder in this key disarms an ignition lock-out system so the car can be started.

er in the steering column charges and then activates a tiny transponder in the head of the key. The transponder contains a small antenna, an integrated circuit with an identification code, and a capacitor. Once charged, the transponder sends its identification code back to the frequency reader via an FM signal. The reader then conveys this code by wire to a control module. If the code is invalid, or if someone tampers with the system, the car won't start, and an alarm sounds.

In the future, the SafeGuard technology could have applications beyond security. For example, as with the Chevrolet Corvette or Oldsmobile Silhouette, it could automatically unlock the doors as you approach [Automotive Newsfront, Oct. '92]. SafeGuard could also create a driver profile for each valid code, so that not only would the doors unlock, the seat and mirrors would adjust. And when you sit down and buckle up, the system could even start your engine.

—Suzanne Kantra

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CONCEPT CARS

FROM CHRYSLER'S DESIGN STUDIO

A visit to Chrysler's Pacifica Advanced Product Design Center in Carlsbad, Calif., provided a glimpse of three prototype cars the company will be displaying on this year's auto show circuit: Venom, Aviat, and Espresso are their names, and they're all based on the new Dodge/Plymouth Neon.

The rear-drive Venom projects a



Chrysler's Venom concept car could bite into the macho-minicar market.



Engine cooling is accomplished via fairings at the rear of the Aviat.

macho performance car image in the Dodge Viper idiom, powered by a 214-horsepower V6 engine. Constructed on Chrysler's lightest platform, the Venom features many sheet-metal components fabricated from aluminum instead of steel. Imagine a Neon on testosterone injections with exciting acceleration and affordable performance as the concept.

The Aviat sports coupe embodies aspects of both a fighter plane and an economy car. Ultra-slippery shaping brings the drag coefficient down to 0.20, while an all-aluminum body trims weight. Computational fluid-dynamics software, developed with help from aircraft builder Northrop Corp. and run on a Cray supercomputer, guided the designers toward locating the engine-cooling system in ducts that resemble a boattail aft end in order to achieve a more aerodynamic car. Power is supplied by the efficient 2.0-liter Neon engine.

Short, tall, and bubble-eyed describe the Espresso, a concept vehicle Chrysler's designers think of as a "family taxi." The project began with a Neon engine and platform, but two feet of length were chopped off the frame in favor of some extra headroom. The storage area under the front seat is designed to meet current airline standards. Efficient urban transportation with ease of parking is the Espresso idea.—*Stuart F. Brown*



The bubble-eyed Espresso rides on a frame that is two feet shorter than the Neon's.

PREVIEW DRIVE

RIVIERA: A NEW DESIGN APPROACH

Buick's new Riviera, the first major reprise of Buick's iconoclastic coupe since 1989, stiffens a sleek and elegant body shell with a new approach to structural design. This effort is part of a commitment to match the body integrity and road manners of the best European cars.

Buick will share some of its structure with Oldsmobile's Aurora, a four-door sedan powered by a new, multivalve V8. Both cars were engineered to set new standards for body integrity, but the Riviera will be powered by GM's latest 3800 V6. Rated at 205 horsepower with 230 pound-feet of torque, this V6 reaches 225 hp with 275 lb.-ft. of torque with a supercharger.

This engine sets the tone for a car less aggressive than the Aurora, but one that is at least equally agile. The body stiffness, claimed to be

in excess of 25 hz—ranking ahead of the old Mercedes 300—is achieved by additional structure, and redesigned weld joints and body sections. The result is a fairly heavy chassis that is actually wider than the Buick Park Avenue. The stability is noticeable on the road, where the response to steering input seems accurate, although not unduly quick, and a pothole is encountered as a single, solid thump.

The Riviera also is the first GM car to profit from an intensive ergonomic study on passenger comfort, which is the conclusion of massive research concerning the pressure distribution of various human body types. The result is redesigned seat proportions that are comfortable and supportive and will stay that way.

The car's structural advances, improved seating, and outstanding powertrain add up to a harmonious whole, wrapped in one of the best-looking bodies GM has presented in decades.

—*Dan McCosh*



NEW MODELS

PORSCHE'S EXPANDING FUTURE

Porsche has been through tough times in recent years, especially in the U.S. market, where sales have shrunk from 30,000 in 1986 to about 4,000 units per year in 1993. But the company is finding creative ways of doing business that are improving its overall health.

In March 1990, Porsche struck a deal to build the Mercedes-Benz 500E. This E-class (midsize) four-door sedan features a high-powered five-liter V8 engine, big tires, and flared fenders. Thus far, some 1,000 Porsche-built Mercedes 500Es have been sold in the United States.

Porsche then entered an agreement in June 1993 with its cousin company, Audi, to create another joint venture, the very sporty Audi station wagon now known as the Audi Avant RS2. It debuted at the 1993 Frankfurt Auto Show and should be on the European market within a few months.

The car features a 315-horsepower 2.2-liter 20-valve 5-cylinder engine, a 6-speed transaxle, all-wheel drive, 17-inch wheels and tires, and Recaro sports seats. Over the next two years, Porsche will assemble about 1,000 Avant RS2s at its main Zuffenhausen works.

Two years ago, Porsche itself aroused great press and public interest with a concept vehicle it called the Boxster, an ultramodern roadster to be built by Porsche and sold at significantly lower prices than its 911, 968, and 928 models. The Boxster drew rave reviews, and the company has decided to go ahead with the project, which will involve yet another of Germany's major car producers.

Porsche officials recently announced that the Boxster roadster project, the 986, will include body panels from BMW. (Porsche has always used body stampings made by outside suppliers, but this is its first venture with BMW.)

The Boxster, still resembling its show-car appearance but now modified to meet regulations, will debut in 1996 as a 1997 model. The roadster will be powered by a horizontally opposed (flat) six-cylinder engine, using a combination of water-cooled cylinder heads and an air-cooled block, like most recent Porsche racing engines. A four-cylinder engine is being developed for the vehicle, in case world fuel supply conditions change. The projected price for the new roadster is \$39,900.—*Jim McCraw*

PS

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GXL Series



ELECTRONICS

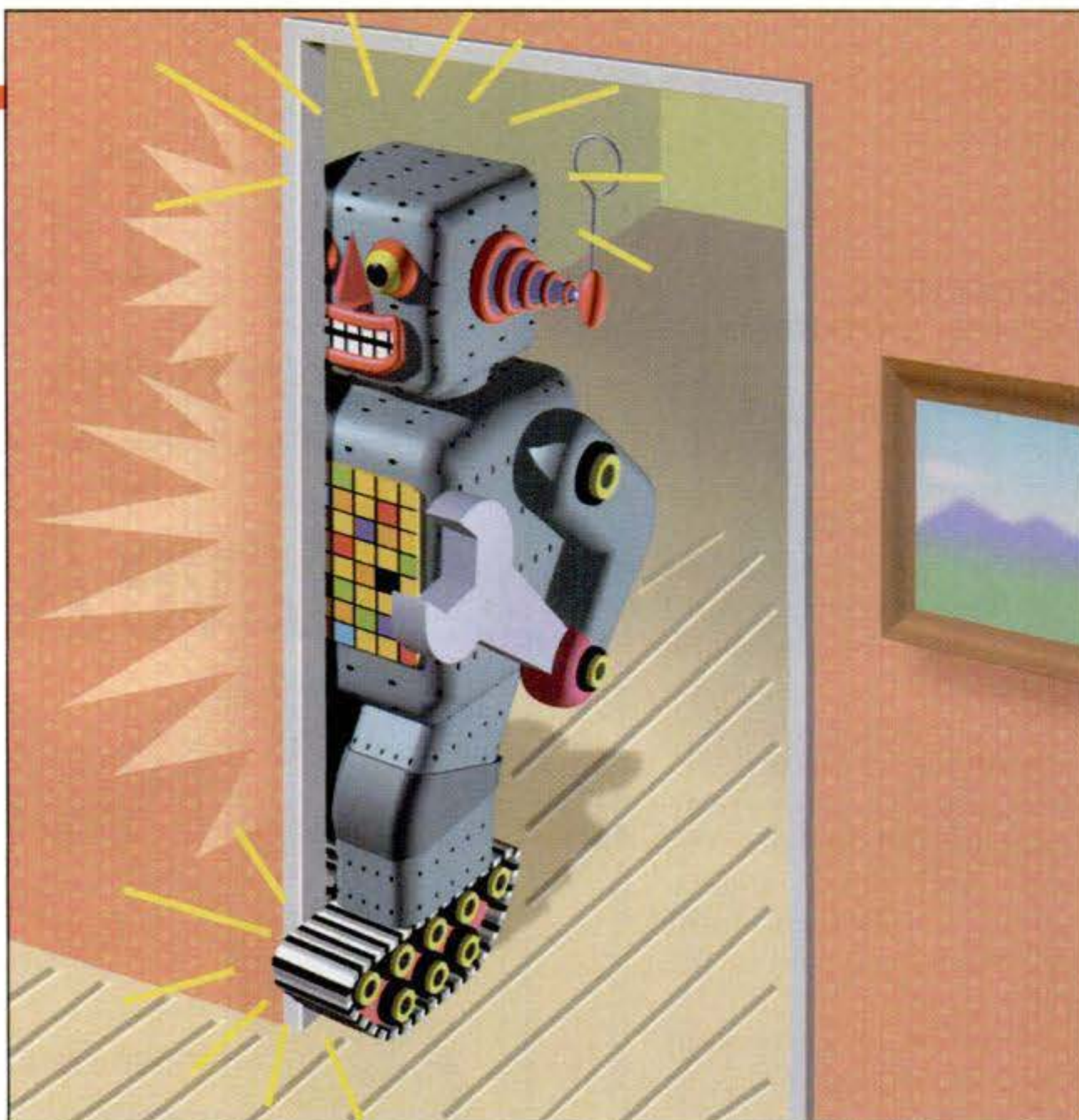
EDITED BY MICHAEL ANTONOFF

ROBOTICS

ROBOT ASKS, WHERE AM I?

One of the toughest nuts for robotic engineers to crack has been dead reckoning—the ability of a self-steering robot to figure out where it is in relation to the world around it. Without this understanding—or humans to point the way—a robot has difficulty navigating preplanned routes, even if equipped with a detailed map, plentiful sensors, and bucketfuls of computational power.

One promising solution may be computerized opto-electronic navigation and control (CONAC), a system that works like a small-scale version of the government's Global Positioning Satellites (GPSs). Developed by MacLeod Technologies of Chelmsford, Mass., this system equips the robot with an infrared laser beacon that spins at high speeds, sweeping around the room. Three or more strategically placed sensors pick up this beacon, then relay the informa-



GPS-like technology helps robots know where they are located in an environment.

TOM CUSHWA

tion to a 486-based PC, which uses triangulation and a preprogrammed map of the area to calculate the robot's position. CONAC completes 25 position updates each second; that's fast enough, says developer Edward MacLeod, to enable the system to steer a vehicle traveling 50 miles per hour, and accurate enough to maneuver a full-size car into a tight parking space. The company claims that its positioning accuracy operates to within 1.3mm indoors and

is only slightly less accurate outdoors.

CONAC has significant potential for factory, office, and security applications; delivery operations; and military and aerospace uses. Under a Department of Education grant, the company has also built a prototype, battery-powered wheelchair. It relies on voice commands to steer itself through a home and uses ultrasonic sensors to navigate around obstacles.—*Judith Anne Gunther*

ELECTRONIC ORGANIZERS

DIGITAL DIARY, TELL ME TRUE

Even before personal digital assistants became available in the United States, U.K.-based Amstrad began shipping its PenPad 600, a pocket-size device that uses less sophisticated processors to accept input from a stylus rather than a keypad.

Five applications are built in: an address book, desk diary, to-do list, notebook, and metric conversion table. Functions are accessed through icons along the top and side of the screen. Applications are sufficiently linked so that when you assign a task to be completed in your to-do list, a reminder is automatically inserted on the appropriate day in your diary.

Priced at \$499, the palmtop electronic organizer is controlled by

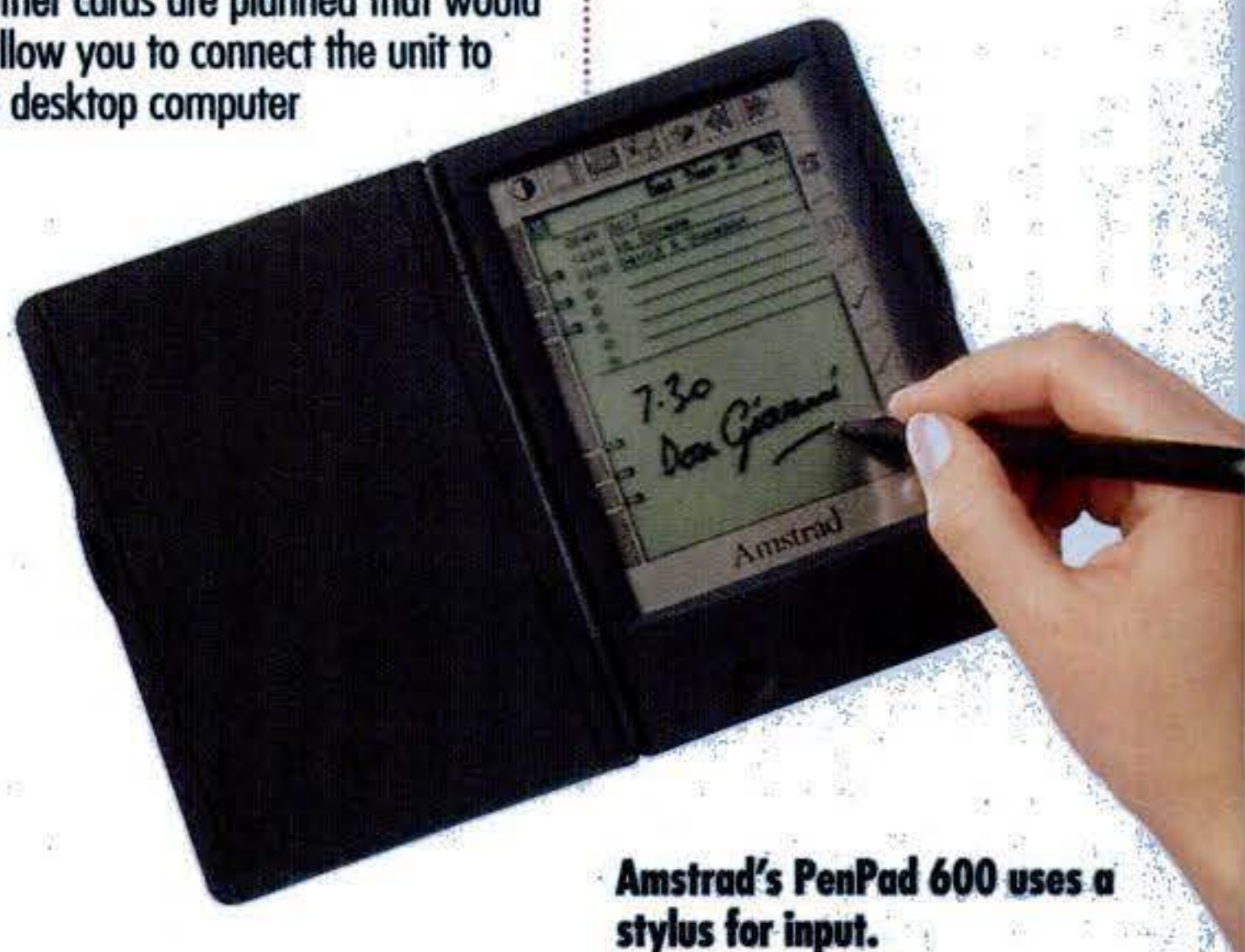
three eight-bit processors. The primary processor handles the application you are working in, while the two additional processors control power and character recognition. The device's three AA batteries last roughly 40 hours. Despite its lack of processing power, the PenPad is suitable for organizing and scheduling, and it has some unique personal touches, such as a conversion table.

The unit's built-in handwriting recognition works strictly with block letters. Recognition is character-rather than word-based. You write letters and punctuation marks in individual boxes. Your penmanship is slowly converted into neat text and inserted into the current application. Script characters and doodles can be stored as "electronic ink" (see photo).

Weighing only 14 ounces, the PenPad features a PCMCIA slot that

accepts memory expansion cards or other ROM-based applications such as travel guides and spreadsheets. No titles are available yet, however. A fax/modem is promised, and other cards are planned that would allow you to connect the unit to a desktop computer

or printer. [For a comparison of the Newton and Zoomer PDAs, see *Computer Newsfront*.]—*Marcelle M. Soviero and David Scott*



Amstrad's PenPad 600 uses a stylus for input.

HOME GARDENING BREAKTHROUGH!

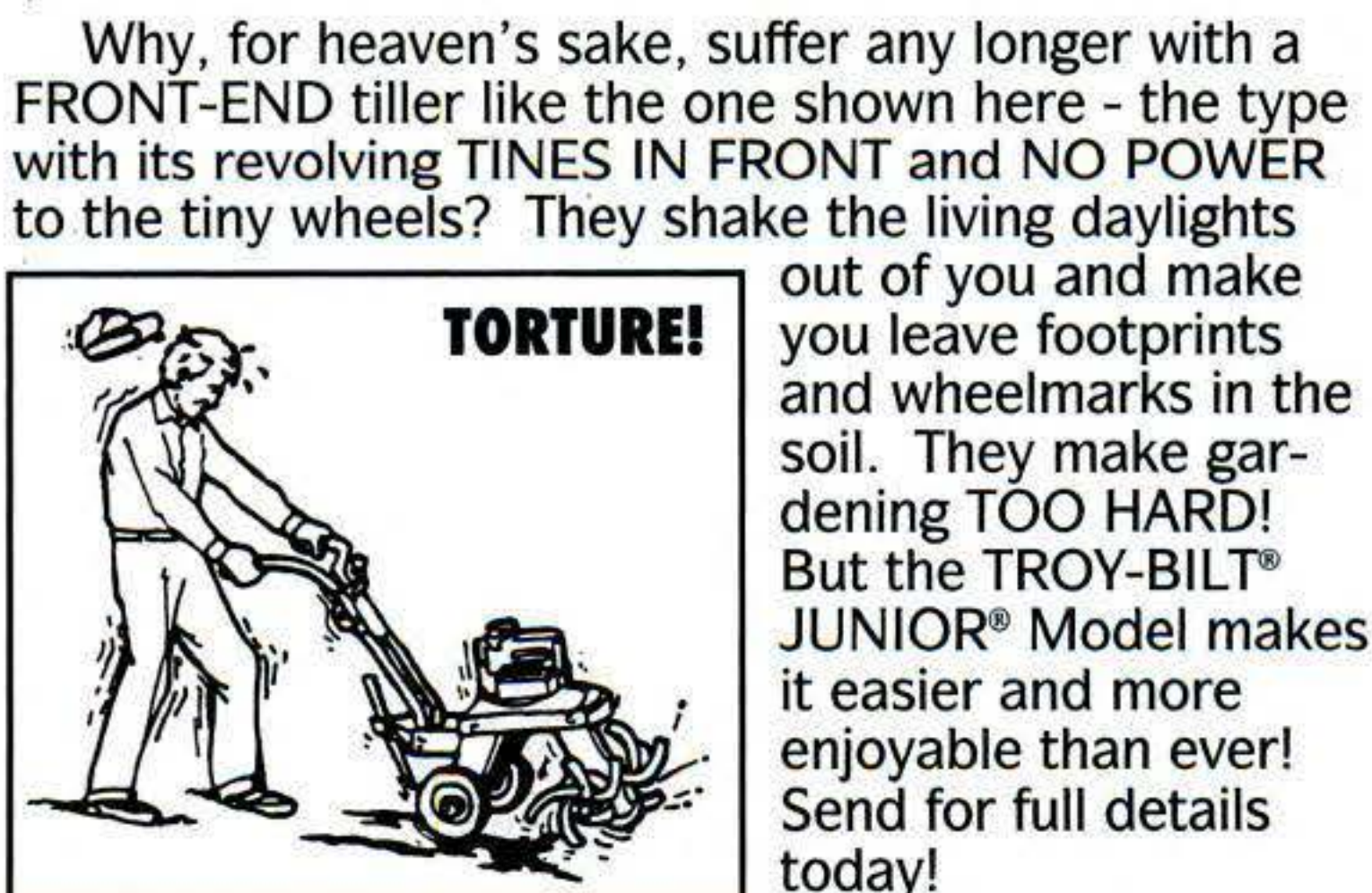
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TELEVISION

REINVENTING THE CATHODE-RAY TUBE

The colors are as bright and crisp as those seen on a conventional picture tube. Only the shallow depth of the cabinet of Matsushita's Flat Vision TV told me I was seeing something new in flat-panel displays.

The Flat Vision picture matches that of the best conventional TVs because Matsushita uses the same principle—in effect, flattening the cathode-ray tube ["Best of What's New," Dec. '93]. In both a conventional CRT and Flat Vision, the image the viewer sees is made up of glowing red, green, and blue phosphor dots painted on the inside surface of the glass screen. These dots glow when hit by a stream of electrons, their brightness varying according to the strength of the

beam. In conventional cathode-ray tubes, three beams—one each for red, green, and blue—are generated by either a single electron gun or a group of three such guns at the rear of the tube. The direction of the beams is controlled by magnetic fields produced by electric coils wrapped around the tube. The beams sweep from left to right and from top to bottom, hitting each of the phosphor dots in turn. This is what makes conventional CRTs so bulky; as a screen gets bigger, the electron gun must be pulled farther away from the front screen so that the electron beams can hit the corners.

Matsushita's new Flat Vision solves this problem by having multiple sources of electron beams. The 14-inch TV has 44 so-called line cathodes, each of which emits electrons from 222 points along its length, creating 9,768 electron beams. Instead of three electron beams scanning the entire screen, each of these 9,768 electron beams scans only those phosphor dots on a 0.18-by-0.05-inch portion of the screen. The electron

beams are focused and aimed by a series of five electrodes arranged in sheetlike layers located between the line cathodes and the phosphor-coated screen. The electron beams pass through tiny holes or slots in these electrodes. Instead of magnetic fields controlling the direction of the beams, electric charges electrostatically deflect, or aim, the beams to hit the proper phosphor dots.

The major advantage is the shallowness of the Flat Vision panel—just 3.9 inches, or less than one-fourth the depth of a conventional 14-inch TV. What's more, bigger screens won't get much thicker. The viewing surface is also perfectly flat, making it easier to avoid glare.

Unfortunately, several drawbacks may keep Flat Vision from becoming the ultimate flat-panel display. The

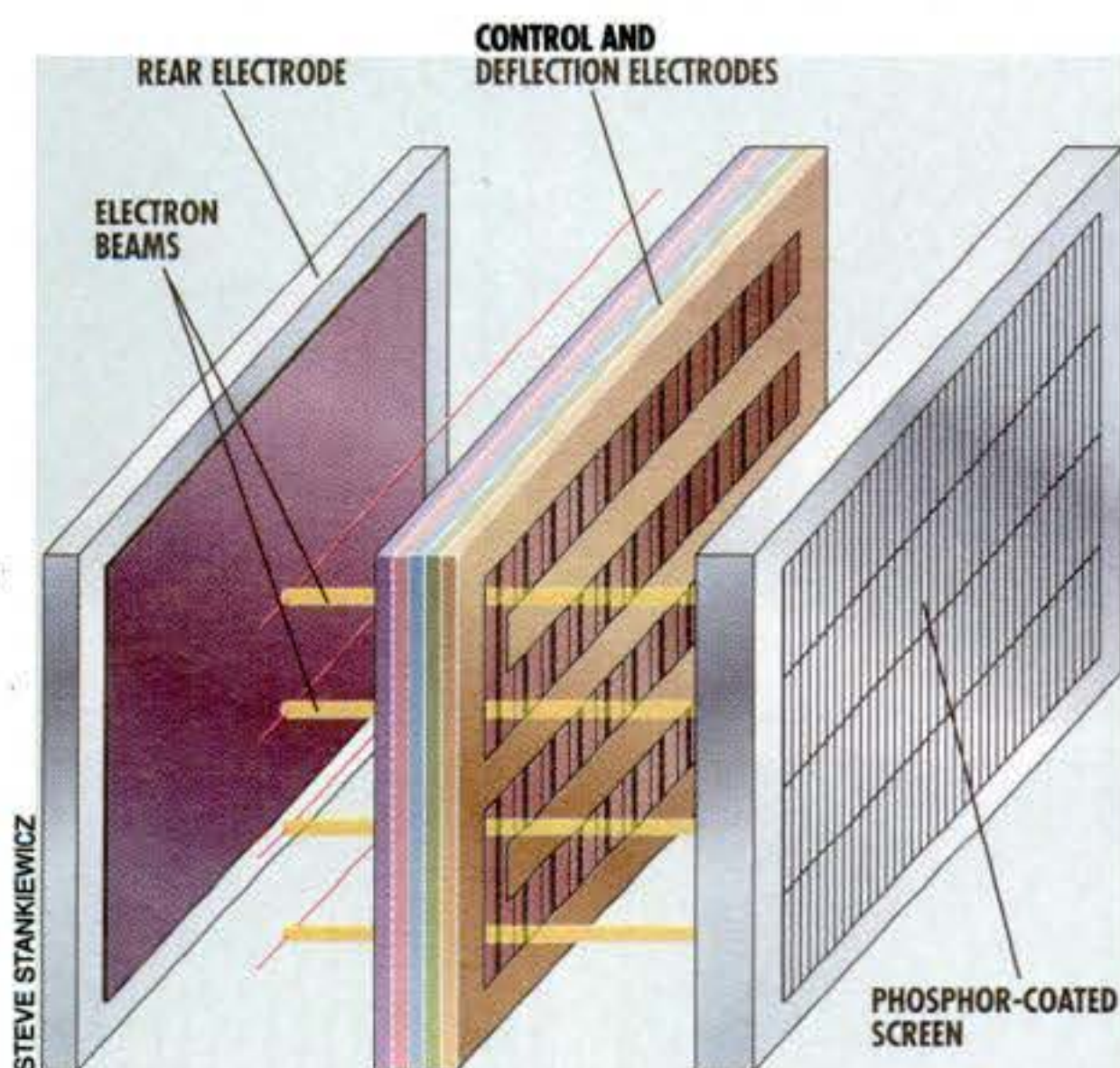


The 14-inch Flat Vision TV saves space.

first is cost. The 14-inch television that entered the Japanese market last fall under the Panasonic brand goes for \$2,500—ten times the price of a small color TV. The company says this sticker price results from the complex circuitry required to drive and control those 9,768 electron beams.

The circuitry saddles Flat Vision with another problem: weight. At 36 pounds, the Flat Vision TV is 50 percent heavier than a standard 14-inch TV. This heftiness, along with the machine's ravenous power consumption and the relative thickness of the panel as compared to liquid-crystal displays, means this technology will not replace LCDs in notebook computers. Using Flat Vision for very large flat panels also involves challenges. Just as with cathode-ray tubes, the inside of the Flat Vision panel must be vacuum sealed for the electron beam emission to work. To withstand the pressure of such a seal, the glass of the Flat Vision screen must get much thicker as the screen grows larger. Matsushita engineers say this may restrict future screens to 30 inches.

Flat Vision technology is likely to prove most effective for nonportable TVs and computer monitors in the range of 14 to 30 inches, in spaces where depth is limited. Matsushita is planning to release a similar desktop-computer monitor this year.—Dennis Normile



Five electrode layers are sandwiched between the line-cathode-emitting rear electrode and the viewing screen.

VIDEO RECORDING

SETTING UP FOR PROGRAMMING BY PHONE

Gemstar's VCR Plus+ has become a hit by shielding VCR owners from the supposedly cruel complexities of programming a tuner/timer for unattended recording. Now comes a new version, VCR Plus+ with CallSet, designed to make the product even friendlier by automating the formerly torturous setup process.

Call an 800 number, punch in a personal identification number, and answer a few questions about your equipment. Then hold the phone up to the clamshell-shaped VCR Plus+ de-

vice, and setup codes will leap across. The operator will ask you to punch a few buttons to make sure the codes got through. Then, set the unit near your VCR and cable box, and record all you want.

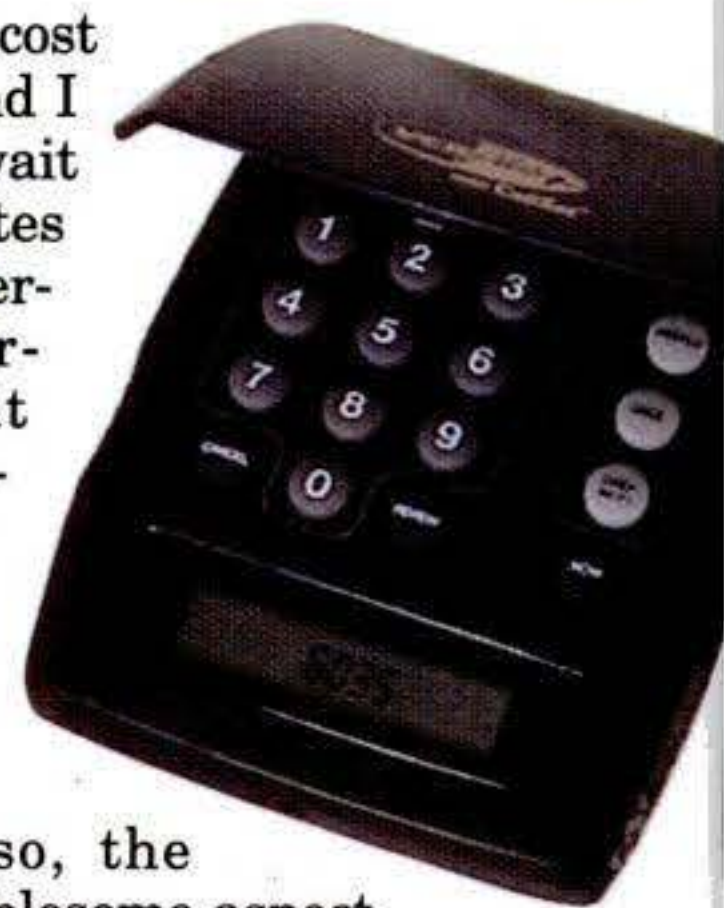
I tried it, and it worked. VCR Plus+ had no trouble recording both network programs and more obscure channels.

There are a few caveats, however. The system requires that you keep the cable box switched on and the VCR turned off; when I tried it with the cable box off, VCR Plus+ wouldn't work. It turns out it isn't programmed to activate power switches on cable boxes.

If you replace your VCR with a different brand, you'll have to repeat the setup routine. Setup calls after the

first one cost \$4.95. And I had to wait 20 minutes for an operator during what was apparently a late-afternoon rush.

Even so, the only troublesome aspect of the VCR Plus+ system is what it says about the public: With on-screen menus as a guide, programming a VCR should be a snap—yet, Gemstar has tapped into America's technophobia.—Mark Fleischmann



VIRTUAL REALITY

WALK-THROUGH MOZART

Someday, we may all be able to immerse ourselves totally in a musical performance in the same manner as I recently experienced Mozart's Quartet No. 21 in D Major.

To "enter" the concert hall, I donned a head-mounted display unit that showed computer graphics and contained headphones. Granted, the contraption was a bit bulky, but, hey, this was virtual music.

I was monitored by a Polhemus Navigational System, a magnetic sensor that tracked my position in a New York art gallery and fed it into a computer. Two standard desktop computers outfitted with a Convolvotron (a specially designed sound board) provided the 3-D sound, using digital signal processing. An additional Intel Pentium-based computer ran all the graphics programming, so that when

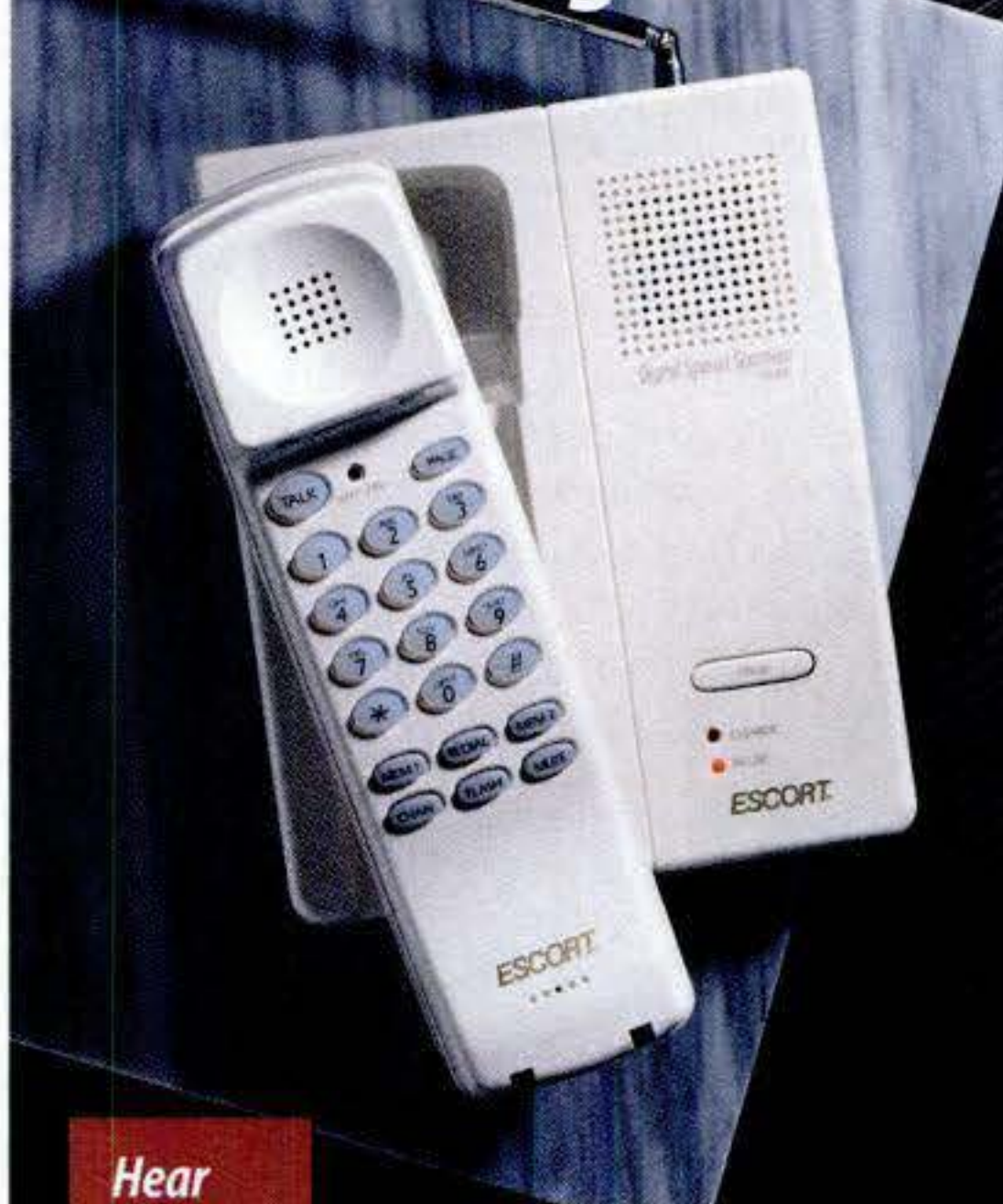


When you click on one of these virtual musicians, a string quartet turns "improvisational."

I turned or walked behind a musician, my perspective adjusted accordingly. If I pivoted my body to face the front left corner, for example, I'd get a bird's-eye view of an animated viola player. As I walked toward a member of the quartet, the music coming from that particular instrument grew louder. When I pointed and clicked a joystick I was holding, I could "tickle" a musician. The character would bust into an "improvised" jazz or bluegrass solo. The musician would play the music, but I felt in control of the whole situation. Cool.

The Virtual Quartet, part of an exhibit at the Soho branch of the Guggenheim Museum last fall, was created by recording artist Thomas Dolby and programmer Eric Gullichsen. It was one of the first art exhibits to combine virtual reality and three-dimensional sound [Electronics Newsfront, Aug. '92].—M. M. S.

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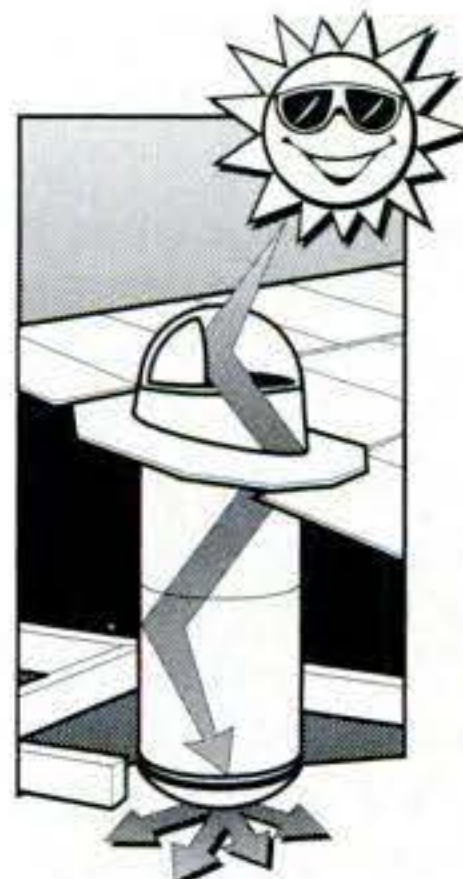
The diffuser looks like a regular light fixture, and it spreads the light evenly, illuminating up to 100 square feet. Sola-Tube fits between the roof rafters and ceiling joists, so no structural modifications are needed for installation.

A professional installation can be arranged, or the average home handyman can install a Sola-Tube in about three hours. Every roof type can

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VIRTUAL REALITY

MONSTER IN 3-D

Though I'd rather floss than play video games, I had a blast piloting a new interactive entertainment device called Virtual Adventures. The machine is a capsule that seats six people and bathes them in digital audio effects and three-dimensional images projected on a large screen. Polarized 3-D glasses help enhance the illusion of depth.

Adventurers settle into the crew seats of a "submersible" craft departing on The Loch Ness Expedition, a mission to ensure the survival of the monster of the lake, whose eggs are men-

aced by bounty hunters and hungry predators. I get the pilot's seat, and around me are our periscope and robotic-claw operators and a navigator. After the craft slips beneath the waves, the scene in front of us shifts dramatically, as we move the controls to steer through the hazardous underwater world. The adventure begins....

The truly interactive imagery is created in real time by an Evans & Sutherland image generator that cranks out high-resolution computer graphics. The company developed Virtual Adventures in collaboration with Iwerks Entertainment, a producer of specialty theaters. More adventures are being created for the capsules, which are designed for installation in public attractions such as theme parks.—Stuart F. Brown



The mission to protect the Loch Ness Monster's eggs faces toothy predators and bad guys in subs.

TELEVISION

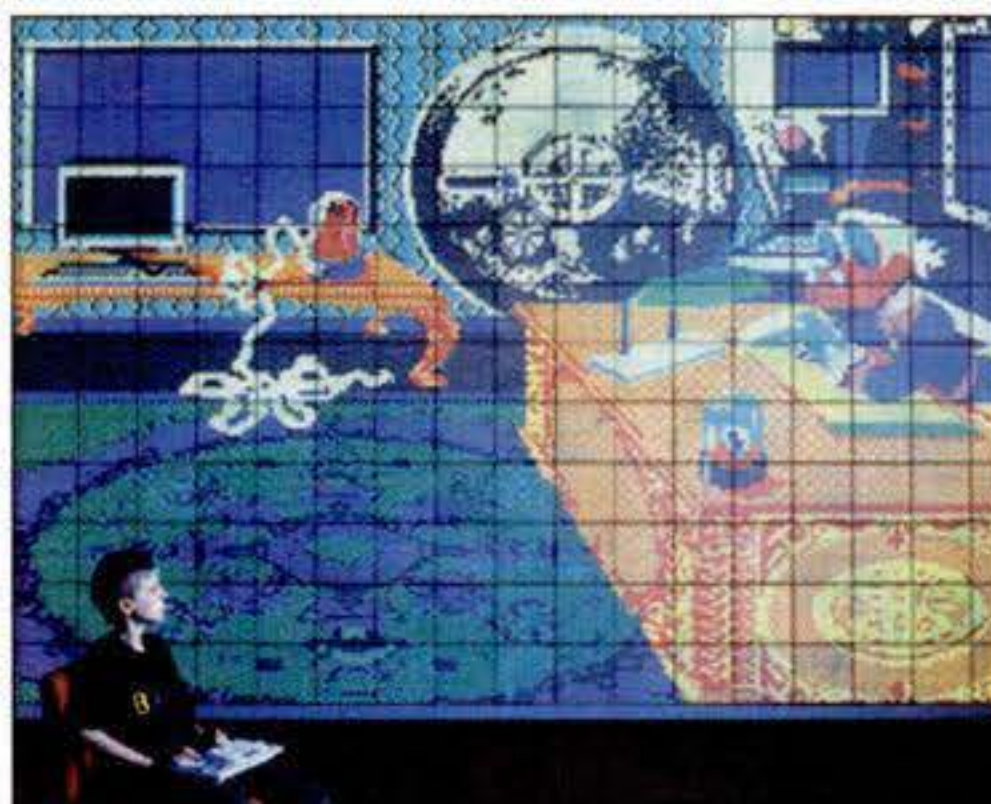
WALL-SIZE FLAT SCREENS

A plasma-discharge flat screen developed in Russia uses modular construction to form full-color display panels of enormous size. At a recent technology expo in Birmingham, England, the Russians exhibited a 101-inch (diagonal) screen. Though billed as a public information board for airports, advertising, and sports events, it's potentially suitable as a big TV screen for living rooms.

The exhibition panel was built from 20 modules, each composed of four gas-discharge displays. Each of these smaller 8-inch squares has a matrix of 1,600 four-color picture elements composed of tiny gas-filled tubes for displaying red, green, blue, and white. The tubes are individually en-

ergized to create a light-emitting ionized plasma via a grid of fine wires.

The image at the expo featured a 40-degree viewing angle and was bright enough to be seen in daylight, but it consumed a hefty 3.5 kilowatts. The Russians have built a 60-module board measuring 184 inches for their cosmonaut training center.—D. S.



The 6.5- by 5.4-foot video screen shows a game.

COMMUNICATIONS

AUCTIONING THE AIRWAVES

For a new generation of wireless communicators, the Federal Communications Commission is preparing to auction off parcels of the radio spectrum to the highest bidders. At the same time, the communications industry is vying for the chance to fill those frequencies with new paging and faxing services, as well as text, voice, and even video mail. Referred to as personal communications services, or PCS networks, the result could be a composite communications system designed to keep you in touch effortlessly wherever you go.

The FCC has allocated 160 MHz of bandwidth to PCS. The first auction of frequencies, some once devoted to taxis, truck fleets, and railroads, could begin as early as May.

Services are likely to include land- or satellite-based voice and data communications using hand-held phones and wireless modems integrated into notebook computers and personal digital assistants. Calls will be routed to people rather than to fixed locations. Other services could include ground-to-plane paging, digital voice paging, and acknowledgement (or receipt) paging.—Suzanne Kantra

BATTERIES

SELF-REFRESHING BREAKTHROUGH

Thanks to a nasty trait known as charge memory, traditional nickel-cadmium batteries can betray an unwary camcorder user. Say you make a 15-minute video with a fully charged battery that will ordinarily power an hour of recording. Afterward, you relegate the camera to the shelf for a week or so, then plug it into the charger because you've decided to record another epic. But a rude surprise results: The battery's memory causes it to poop out after only about 10 minutes.

Now, however, Aztec Video has produced a camcorder battery that avoids the problem. Press a button and, if there is less than an 80 percent charge left, the battery automatically self-refreshes by discharging, so that it can then accept a full charge. The battery is available in a variety of models for different 8mm and VHS-C camcorders, at a cost of about \$10 more than a conventional battery.—Arthur Fisher

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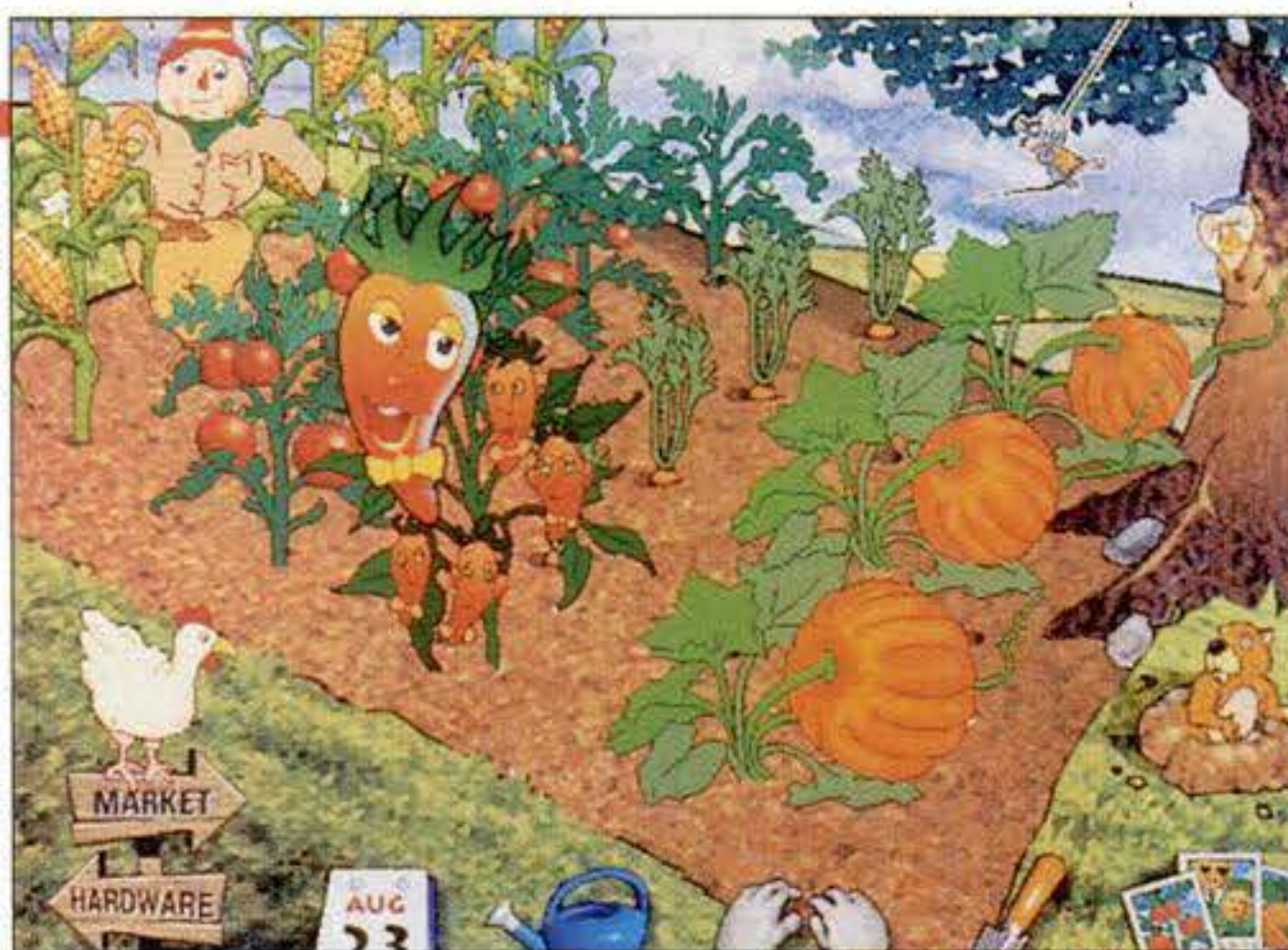
CD-ROM

"EDUTAINMENT" DISCS FOR KIDS

Compact discs excel as a medium for music, and now CD-ROM discs are proving themselves equally compelling for children's software that both educates and entertains.

These "edutainment" programs entice youngsters to learn basic skills or explore specific topics with interactive techniques that draw them into the fun. Puzzles, sing-alongs, and games are often part of the package. Increasingly, so are well-known characters.

Borrowing a page from Nintendo, The Software Toolworks offers a disc called *Mario is Missing! CD Deluxe*, an exploration of geography led by the ever-popular Super Mario Brothers. Up-



Kids can dig around the *Forever Growing Garden* (left) or make their own music videos with *Lenny's Music Toons* (below), two new CD-ROM discs that combine fun and learning.

start 7th Level Inc. is attempting to create a lovable character of its own with *Little Howie*, a teddy bear featuring the voice of comic Howie Mandel. Its first title, *Tuneland*, depicts Little Howie's adventures on an animated farm.

For budding botanists, there's *Forever Growing Garden*, from Media Vision, which lets children "grow" their own flowers or vegetables on the screen. For kids who prefer the director's chair, there's *Lenny's Music Toons* from Paramount Interactive. It features six musical playgrounds, filled with animated characters, that children manipulate to make their own music videos. Prices for these CD-ROM titles range from \$30 to \$70. —*Marcelle M. Soviero*



DATABASES

RELATIONSHIPS AMONG THE DATA

If you've ever searched a computer database, you know it's not always easy to find what you want. Asking a database to look up newspaper articles about "computer terminals," for example, might yield dozens of stories on that subject—but the search will probably miss dozens more that use synonyms like "video display terminals" and "monitors." Not to mention acronyms, such as "VDT."

Smarter database-searching methods may be on the way, however. Bell Communications Research, the laboratory cooperative of the regional telephone companies, has devised an ingenious method for locating data without requiring that you become a human thesaurus. The key to the solution? Although articles on the same topic might use different words to describe the same subject, they often contain other words in common.

Employing a computational technique known as singular value decomposition, Bellcore researchers have created software that compares all the documents in a database word by word, and teases out related words. If you ask the program to comb a database for scientific articles about "water," for instance, it will not only turn up documents about the liquid, but also ones about "aqueous solutions" and "ice." It can also rank the stories in order of relevance.

Although the process is only an experimental prototype now, Bellcore says its patented technique could work with any database in any language.—*Robert Langreth*

HOME PCs

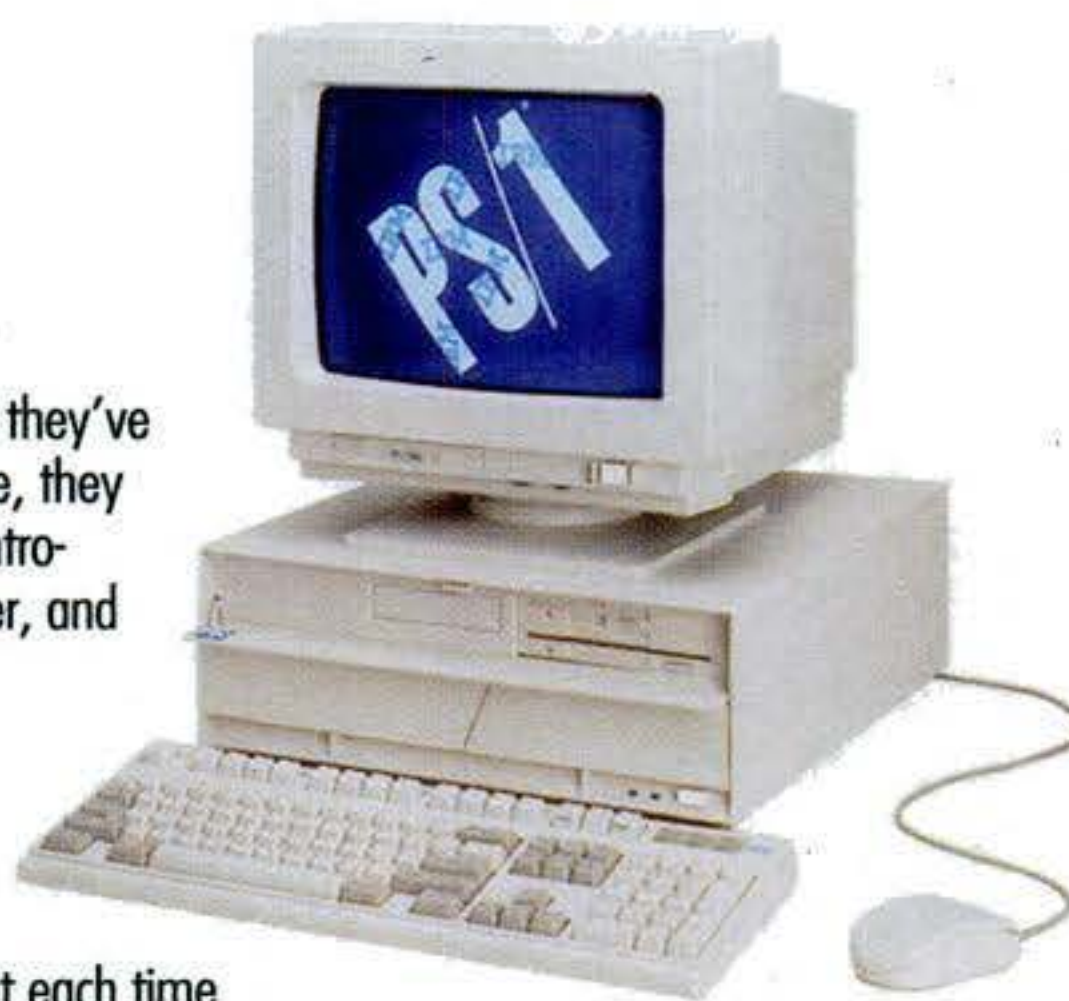
IBM AND APPLE HEAD FOR HOME

The biggest names in personal computers think they've got a home PC with your name on it. This time, they might be right. Apple and IBM each recently introduced new lines of PCs that set up easier, run faster, and cost less than ever before.

IBM's latest PS/1 models are built around 486 chips, and each includes MS-DOS, Windows, and Microsoft Works for Windows already loaded on the hard disk drive. A new feature called Rapid Resume remembers your place in Windows, so that each time you turn on the machine you can pick up right where you left off. The software for dialing up Prodigy and America Online is pre-loaded, and a modem is standard. Multimedia models are available. Prices range from \$999 to \$2,399.

Apple's new Macintosh Performa 550 puts all of the multimedia ingredients—CD-ROM drive, stereo sound, speakers, microphone, and a Sony Trinitron monitor—in one box that requires virtually no setup. It costs about \$2,000. The Performa 460 and 470 models (\$1,299 to \$1,799) don't have all of the multimedia trimmings, but run on faster chips (Motorola's 68030 and 68040) than previous Performas. They include a fax-and-data modem and a wide array of pre-loaded software, such as ClarisWorks and Quicken.

IBM's PS/1 (above) and Apple's Performa (left) models combine faster processors with new communication and multimedia features.



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MS-DOS GETS
A SAFETY BOOST

The world's most widely used operating system software just got a little safer. With MS-DOS 6.0 plagued by sporadic reports that its DoubleSpace utility can cause users to lose information in certain circumstances, Microsoft has introduced an upgrade with what one Microsoft executive called "the software equivalent of air bags and antilock brakes." DoubleSpace compresses data so you can store twice as much on a hard disk.

MS-DOS 6.2, so named to avoid confusion with IBM's PC-DOS 6.1 version of DOS, includes two new features called DoubleGuard and Scandisk. These are designed to ensure that a hard disk can accurately record data before the DoubleSpace utility attempts to shrink any information. Previously, some users had run into trouble by trying to use DoubleSpace with flawed files or disks. Other new options let you uncompress a disk, test for faulty memory chips, and speed up the operation of CD-ROM drives.

If you already use DOS 6.0, you can get the 6.2 upgrade for \$10 in stores, or use a modem to download it from the CompuServe on-line service for free (type GO MSDOS62). If you currently use an older version of DOS, the upgrade edition lists for \$77.95.

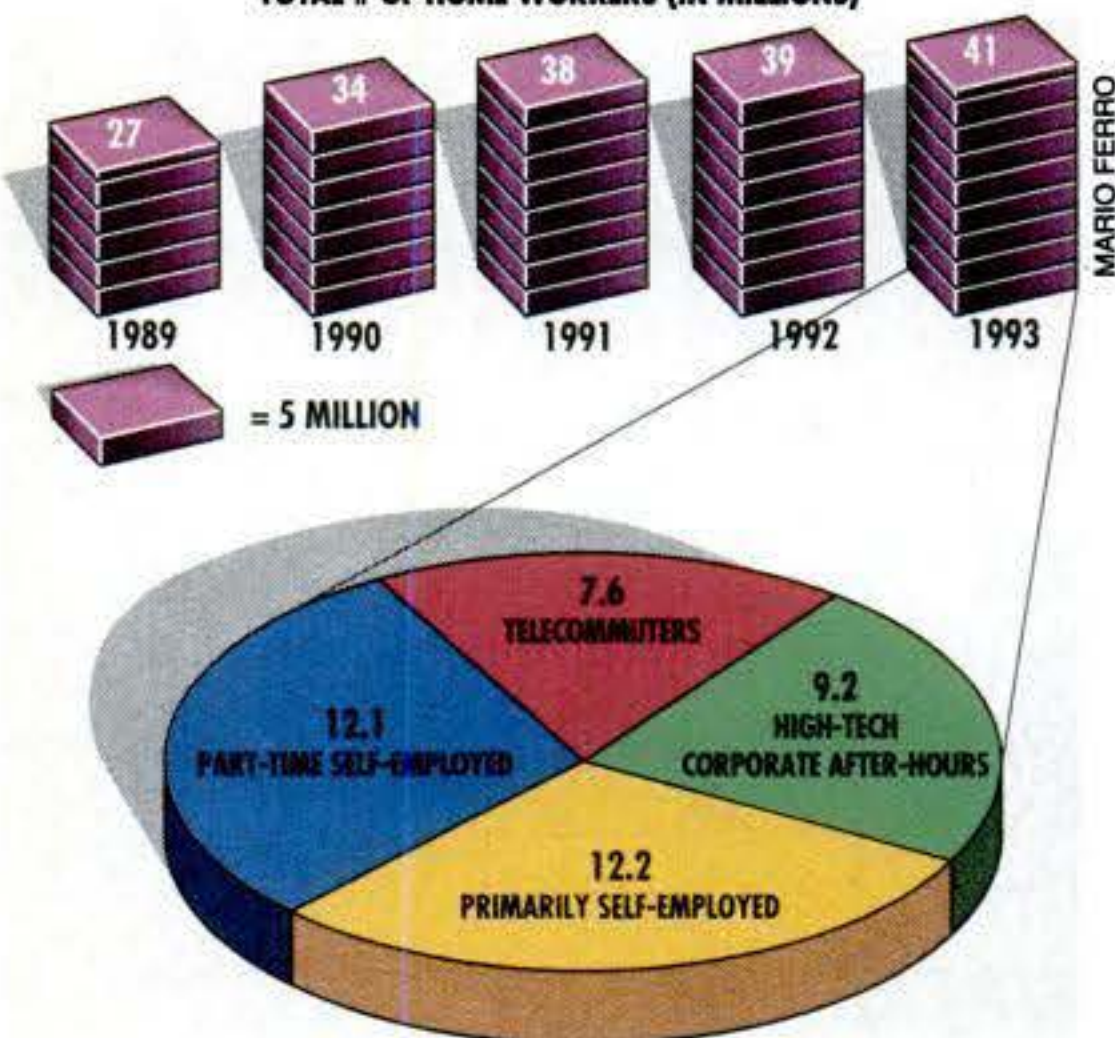
IBM, meanwhile, is offering a "downgrade" of sorts for its OS/2 operating system. OS/2 Special Edition for Windows (\$49) is a streamlined version intended for those who are already running Windows and DOS on their systems.

ing price for a suite, typically \$300 to \$500, is about what you'd pay for a single program.

Lotus and Microsoft offer suite packages of their own programs. Lotus sells its Ami Pro word processor, 1-2-3 spreadsheet, Approach database, Freelance graphics, and Organizer daily planner in a set it calls SmartSuite. Microsoft's Office includes its Word editor, Excel spreadsheet, Access database, PowerPoint graphics, and Mail electronic mail software. Borland, meanwhile, has teamed up with WordPerfect to offer Borland Office. That suite combines Borland's Paradox database and Quattro Pro spreadsheet with WordPerfect's namesake word processor.

While these programs maintain some unique characteristics, they each run under the Windows interface and are usually modified to look and work alike. They can usually share data too.

TOTAL # OF HOME WORKERS (IN MILLIONS)



HOME OFFICE

MILLIONS OF WORKERS
ARE HOMEWARD BOUND

The reverse commute away from the corporate office and into the spare bedroom continues. The number of people working at home in the United States topped 41 million in 1993—up from 39 million in 1992—and now represents a third of the total adult work force.

Personal computers are playing a major role in that growth. The number of home-worker households that own PCs jumped 27 percent in 1993. In all, 58 percent of households with people working at home own at least one PC. Self-employed persons, either working full-time or moonlighting, make up a combined 24.3 million of the total home work force. Company employees working at home during normal business hours—so-called telecommuters—and after-hours workers comprise the remaining 16.8 million.

INTEGRATED SOFTWARE

SUITE DEALS
ON BEST-SELLERS

Does the high price of software leave a sour taste in your mouth? If so, then the Big Four software publishers think they've got the sweets—or rather, suites—for your taste.

Sets, or suites, of popular software programs have become the hottest deals in town. Typically, they combine a word processor, database, and spreadsheet, and often graphics and communications programs. But unlike earlier "integrated" software, which married generic and frequently underpowered programs, the suites combine programs that are already best-sellers in their own right. And the discounted sell-



Princess Maker 2 (top) lets you try your hand at child rearing. With AquaZone (above), you get to feed the fish.

GAMES

RAISING THE KIDS
WITH SOFTWARE

If you like pets and kids, but shrink from the responsibilities they entail, you might want to try raising their digital versions. So-called "raising games" have become the rage in Japan.

One of the most popular simulations is AquaZone, from Tokyo-based 9003 Inc. With some impressive graphics, the virtual fish you select for your virtual aquarium swim around at random—until you drop in some food. They chase after it just as normal fish would. Over time your fish grow larger and even spawn, but they also get sick and die.

In another popular game, Princess Maker 2 from Gainax Co., you take on a far more serious responsibility: raising a daughter from the age of 10 to 18. You help her choose school subjects, decide how much studying she should do, monitor her TV-watching habits, and determine whether to let her take a part-time job. Make the right decisions and you end up with a well-adjusted young woman. Make mistakes and she becomes a juvenile delinquent.

Other programs to watch for: games for breeding race horses and working with insects. Some titles may make it to the United States later this year.

—Dennis Normile

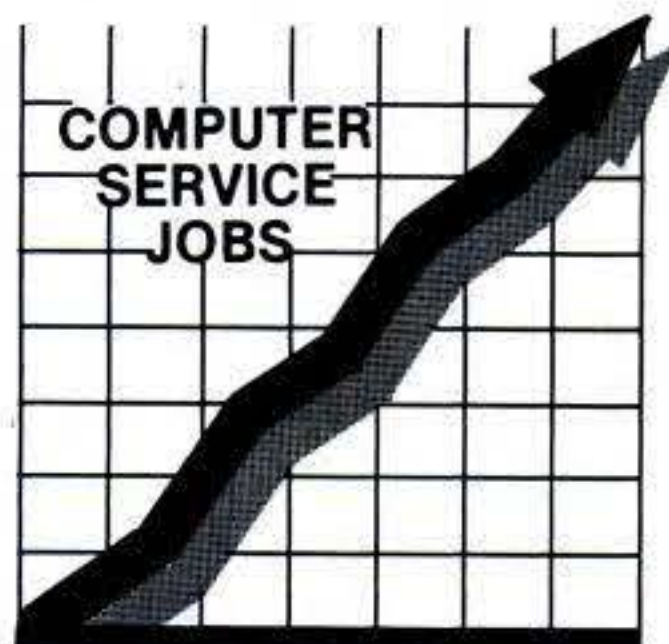
5 sure steps to a fast start as a high-paid computer service technician

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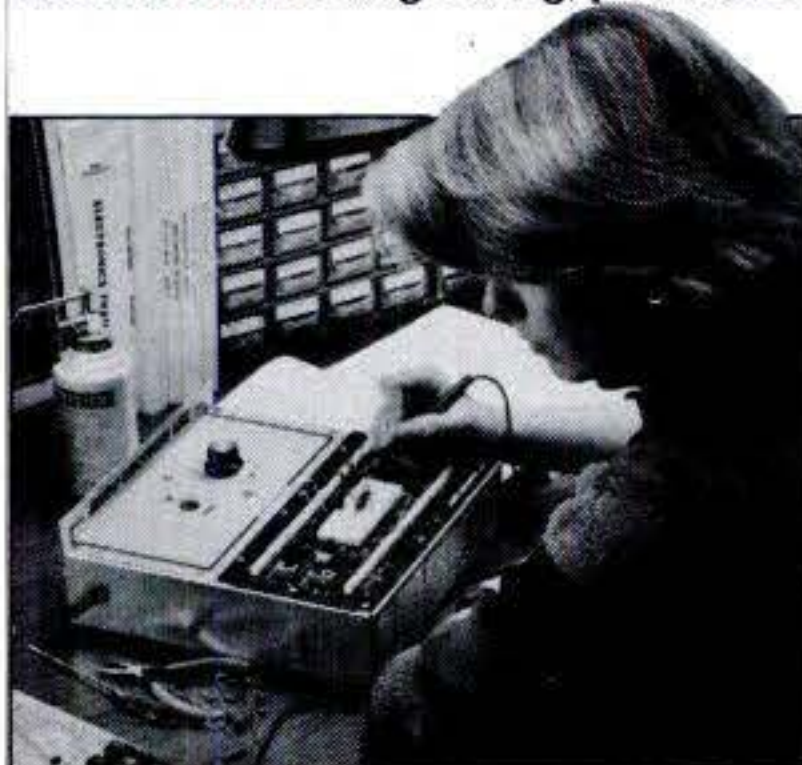
Jobs for computer service technicians will almost double in the next 10 years, according to the latest Department of Labor projections. For you, that means unlimited opportunities for advancement, a new career, or even a computer service business of your own.

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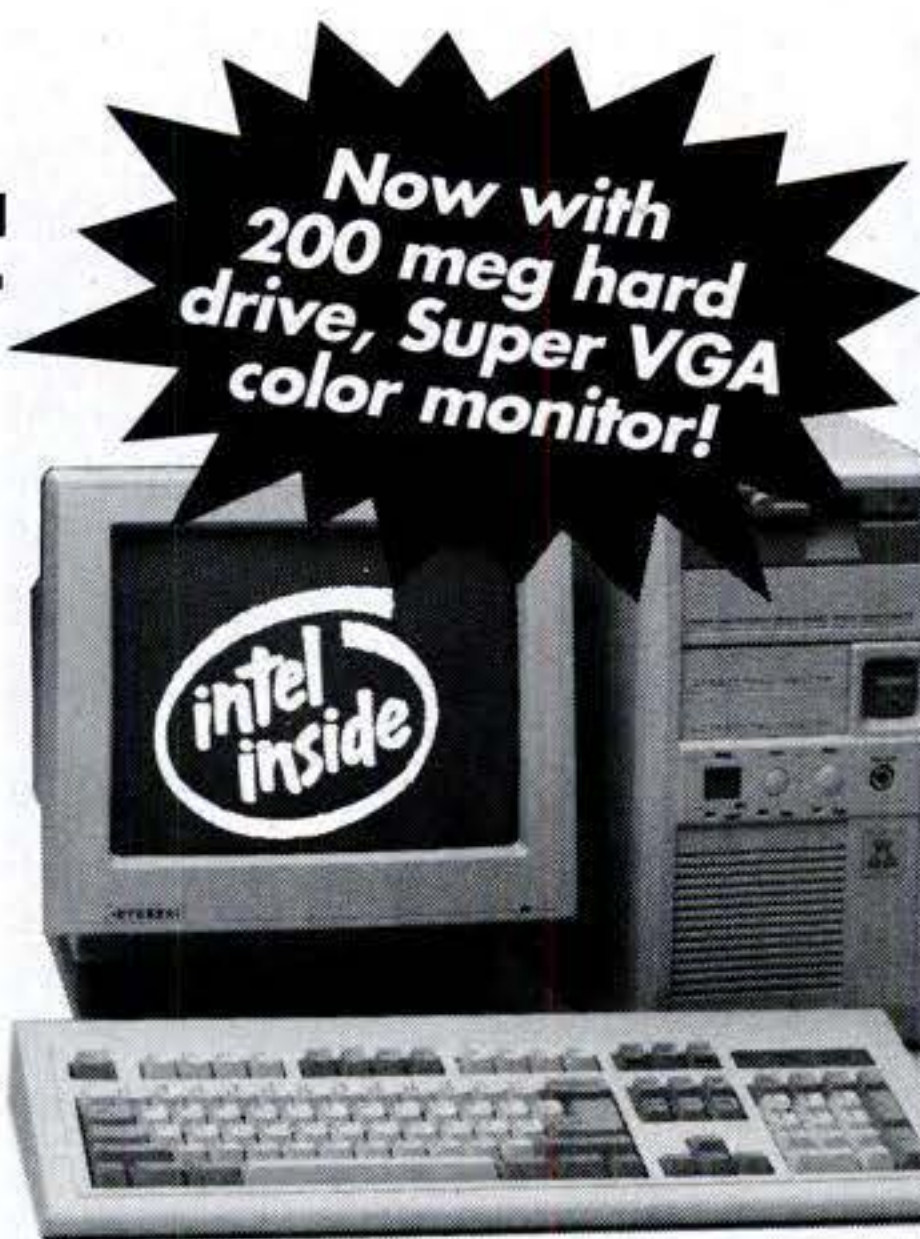
invaluable practical experience. You first read about the subject, studying diagrams, schematics, and photos that make the subject even clearer. Then you do. You build, examine, remove, test, repair, replace. You discover for yourself the feel of the real thing, the confidence gained only with experience.

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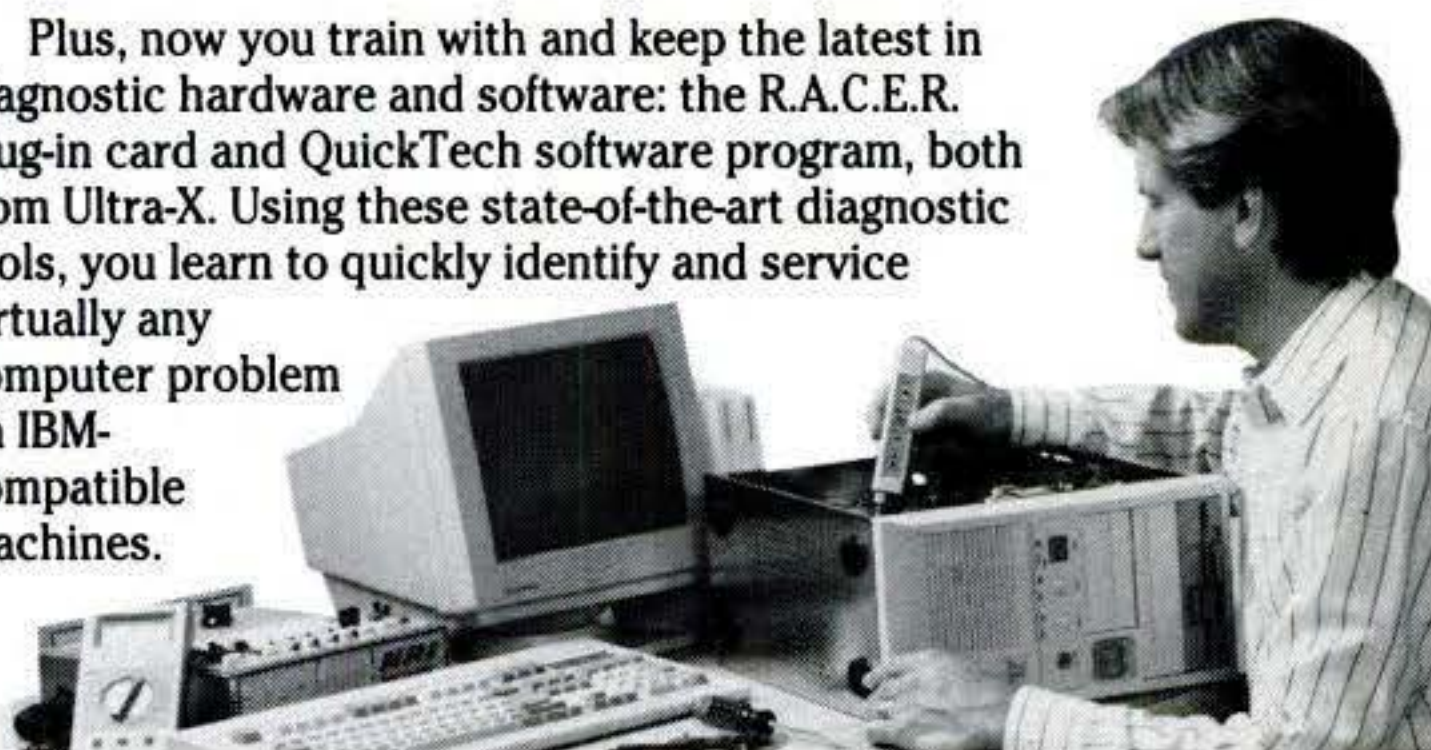
If you really want to get ahead in computer service, you have to get inside a state-of-the-art computer system. That's why NRI now includes a high-speed 486sx mini-tower computer as the centerpiece of your hands-on training.

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Plus, now you train with and keep the latest in diagnostic hardware and software: the R.A.C.E.R. plug-in card and QuickTech software program, both from Ultra-X. Using these state-of-the-art diagnostic tools, you learn to quickly identify and service virtually any computer problem on IBM-compatible machines.



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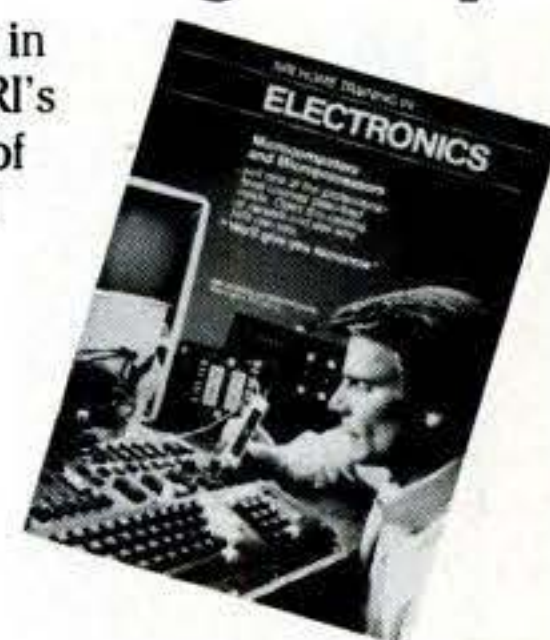
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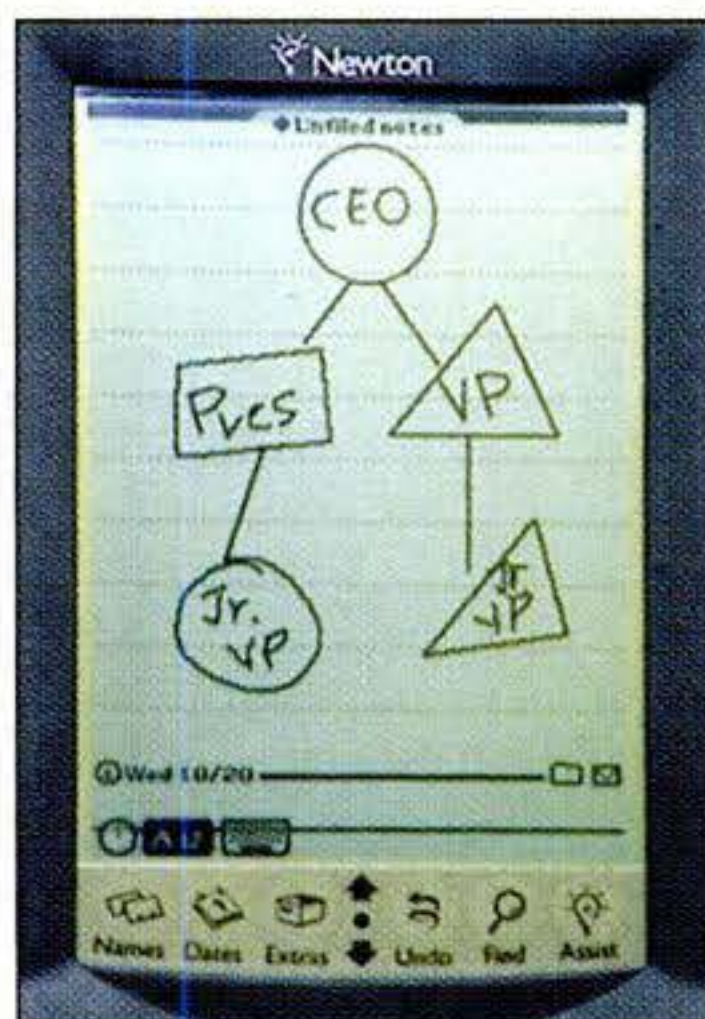
PDAs

NEWTON Vs. ZOOMER

BY MARCELLE M. SOVIERO

Personal digital assistants, or PDAs, are pocket-size appliances that, theoretically, replace keyboards through the use of handwriting recognition and eliminate telephone cords via wireless communications features. But the first real PDAs—Apple's Newton MessagePad and Tandy's Z-PDA Zoomer—fall well short of the ideal. Their handwriting recognition is slow and imperfect, and faxing and messaging functions are expensive, limited options. Still, these early PDAs drip with tantalizing potential.

For now, PDA choices are few. Apple's Newton MessagePad is manufactured by Sharp, which sells a similar device called the ExpertPad. Likewise, Tandy's Z-PDA is built by Casio, which markets a virtually identical Zoomer model called the Z-7000. Each of these devices sells for



Among the duo's handy features are a graphics recognizer in the Newton (above) for tidying up hand-drawn shapes, and a world clock display in the Zoomer (right).

about \$700, though prices vary, depending on where you buy it and the options you choose.

The software in both the Newton and the Zoomer is built around familiar organizing tools, including a

notepad, address book, and calendar. To this repertoire, each adds support for communication activities such as phone dialing, faxing, and electronic mail. And each has its own special touches—a "pocket" edition of Quicken personal finance software in the Zoomer, for example, and a sketchpad that slicks up your drawings in the Newton.

Only days after Apple unveiled its long-awaited PDA, I popped into a local electronics "superstore," plunked down my credit card, and shelled out about \$1,000 for a Newton, a fax modem, and a battery recharger. (The Newton can use either rechargeable nickel-cadmium or standard alkaline cells.) I was immediately entertained—and aggravated. Pulling it straight out of the box, I began using the electronic notebook, which is the first thing that appears when you turn on the Newton (or the Zoomer). I had to look hard to see what I'd written, since the LCD screen is "reflective" rather than lighted. And the Newton's flat pen, or stylus, takes getting used to.

It's clear the Newton has a sense of humor—and you might need



one too, to work with its handwriting-recognition feature for turning hand-scribbled letters and numbers into perfectly formed characters. I wrote my name, and then watched "Marcelle" become "maritime" and, on a second try, "cassette." Whenever I would scribble over a word that Newton had screwed up,

I'd see the word disappear in a cloud of dust, accompanied by the sound of crumpling paper. It's a cute touch, though you have to use it too often.

But you can coax the Newton into doing better. You can load words, like names or job-related terms, into the Newton's dictionary so it will recognize them in the future. You can also adjust the speed of its recognition: The slower you set the recognizer, the more accurate it will be. You'll also improve accuracy if you set the device to recognize either printed characters or cursive writing, as opposed to both. And there's letter-by-letter training for the Newton; each time you use this PDA, its letter recognition improves. The Newton is finally catching on to my curly Qs, but it's still not truly practical for note taking. Instead, I use the "electronic ink" alternative (in which letters are simply saved as pictures).

The Zoomer has similar limitations, but they're more severe. Its screen is dark and difficult to read, and its pen is smaller than a crayon. The Zoomer attempts merely to convert *hand-printed* letters and numbers—not cursive writing—into neat digital characters. Even so, it suffers from the inaccuracy problems similar to the Newton's, and it lacks the Newton's training feature. The Zoomer can store handwritten notes as electronic ink, and can automatically shrink notes to fit neatly on the lines of its address or date book. It has a minuscule pop-up keyboard as well, though it'll try your patience.

The Zoomer definitely holds an edge in staying power. Its three AA-size batteries last up to 100 hours, while the Newton runs for about 35 hours on four AAA cells.

For all the talk of PDAs as commu-

nication devices, the fact is neither the Newton nor the Zoomer comes with even basic fax or data modem circuitry built in. You can connect external modems to each, and both have a PCMCIA card slot for adding modem or pager cards as they become available. These add-ons can be clumsy and costly, however, and are not always wireless. And you may find you need that card slot for other purposes, such as adding memory or running programs. Nonetheless, communications gadgetry will continue to come forth—the Newton's new wireless messaging (pager) card and fax-and-data modem for cellular phone hookups are two of the latest add-ons.

In subtle but useful ways, the Newton seems smarter than the Zoomer. The Assist button in the Newton, for instance, lets you simply write "Fax Bob" in the Notepad, and the device will automatically look up Bob in your address book, get the fax number, and create a fax cover sheet. The Zoomer may seem more familiar to computer users, since it's based on the GeoWorks operating system—not unlike the Windows or Macintosh interfaces—and includes software for dialing up the America Online service.

Odds are that the Newton will soon enjoy the critical advantage of a bountiful selection of software. Apple has convinced scores of software publishers to develop programs for the Newton, ranging from arcade games to business expense trackers. Far fewer publishers appear to be rallying around the Zoomer. But that, like the PDAs themselves, is subject to change.



PATENTS

SNEAK PEEK AT THE COMPUTER FUTURE

Had you seen the patent filings on optical technology in the 1970s, you might have foreseen the coming of CD-ROM drives for PCs. Today, CD-ROM databases of patent information allow anyone to peer into the future of technology.

A year of U.S. patents—more than 100,000 text abstracts—fits onto a single CD-ROM disc (\$199) from MicroPatent (800-984-9800). The DOS software lets you search by topic, patent holder, or other criteria, and monthly updates are available. For a more historical perspective, you can turn to Patent Scan, a collection of discs from Rapid Patent (800-336-5010) that enables you to browse through the patents granted during the last 20 years. However, the cost ranges from \$995 for a starter kit to \$5,000 for a complete set. Rapid Patent and Electronic Data Systems also offer an on-line service called Patent Analyzer, which costs \$45 to \$495 per search.

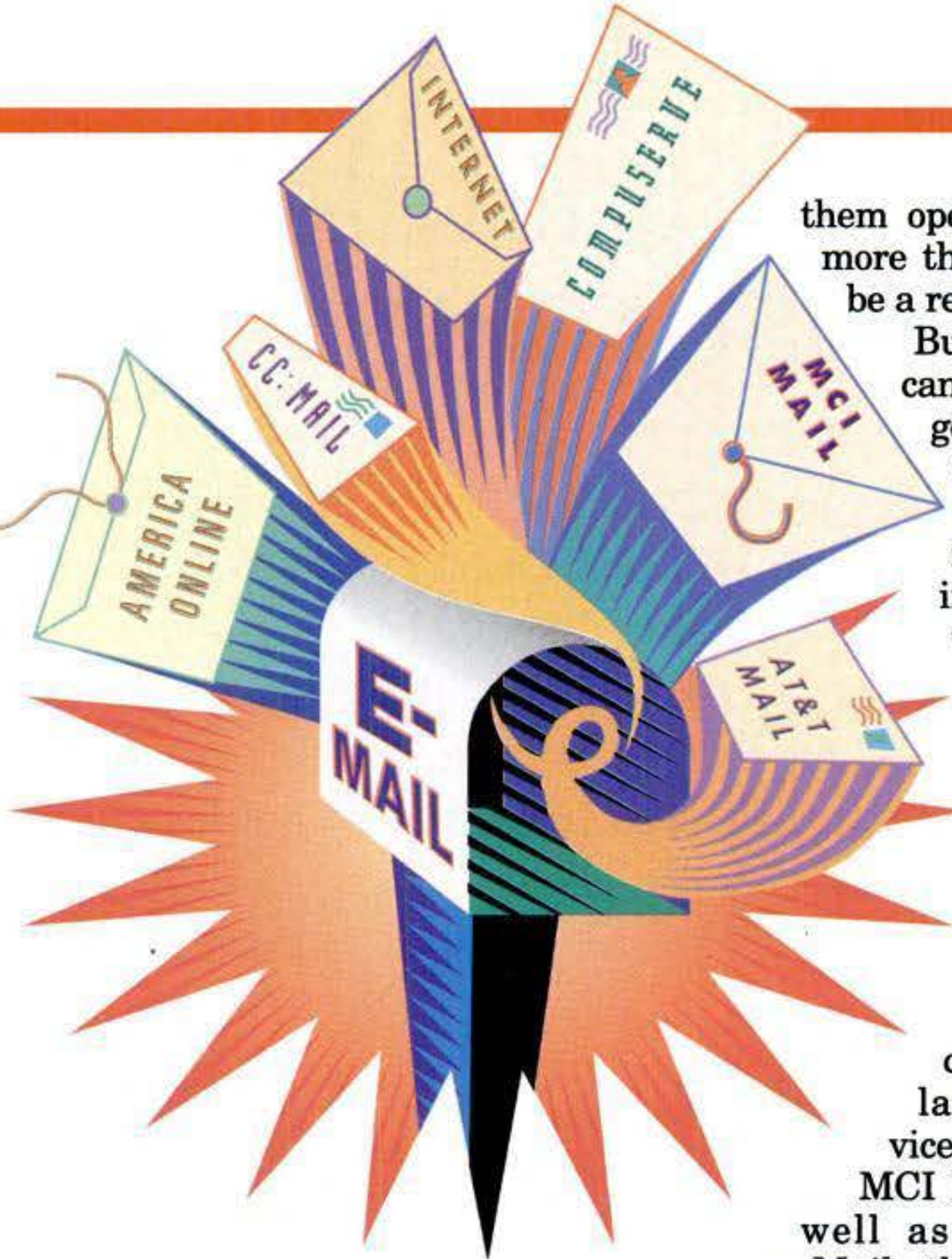
Many worthwhile innovations aren't patented, however. Knowledge Express (800-248-2469) runs on-line databases with more than five million, mostly non-patented developments coming from government agencies and universities. Passwords are \$250; on-line fees for searches start at around \$25.—*Mark Henricks*

UPDATE

PC CARDS GET A STORAGE STANDARD

Sliding a credit card-size hard disk into a portable computer may soon be a lot easier. A new standard for hard disk and flash memory cards is designed to ensure that PC-card storage devices can work in any type of laptop or handheld computer. The new design rules, called PC Card ATA, are a subset of the PCMCIA standards [Computer Newsfront, Nov. '93] and have been endorsed by IBM, Maxtor, Seagate, SunDisk, and Toshiba.

The next step may be to store a custom set of software programs inside a PC card. A small Phoenix company called Computerized Data Systems for Manufacturing recently developed such a card, which uses removable ROM chips that each contain an application program.—*M. M. S.*



E-MAIL

ONE MAILBOX FOR ELECTRONIC LETTERS

There are at least a half-dozen public electronic mail services that can zap messages from your PC to someone else's, and still more that can handle deliveries between PCs on private networks. The trouble is, all of

them operate differently, so using more than one e-mail system can be a real hassle.

But a new breed of software can handle the comings and goings of several e-mail systems. These programs provide "gateways" to two or more e-mail services, helping you navigate through the maze of multiple systems with a single interface and address book.

The most ambitious (and expensive at \$395) of these gateways is Cyberdesk, from Cyber-Corp (404-424-6240). Cyberdesk is a Windows program that simplifies connections to some of the largest public e-mail services, including CompuServe, MCI Mail, and AT&T Mail, as well as Internet and Lotus's cc:Mail, the most popular private-network system.

E-Mail Connection, a \$79 Windows program from Connect Software (800-234-9497), is a similar product that specializes in links to CompuServe and MCI Mail. A version that handles Prodigy is in the works, as is a Macintosh edition. MailPlus, a \$99 Windows program from Computer Mail Services (800-883-2674), also works with MCI Mail and CompuServe.—*Jonathan D. Beard*

LINDA BLECK

SCANNERS

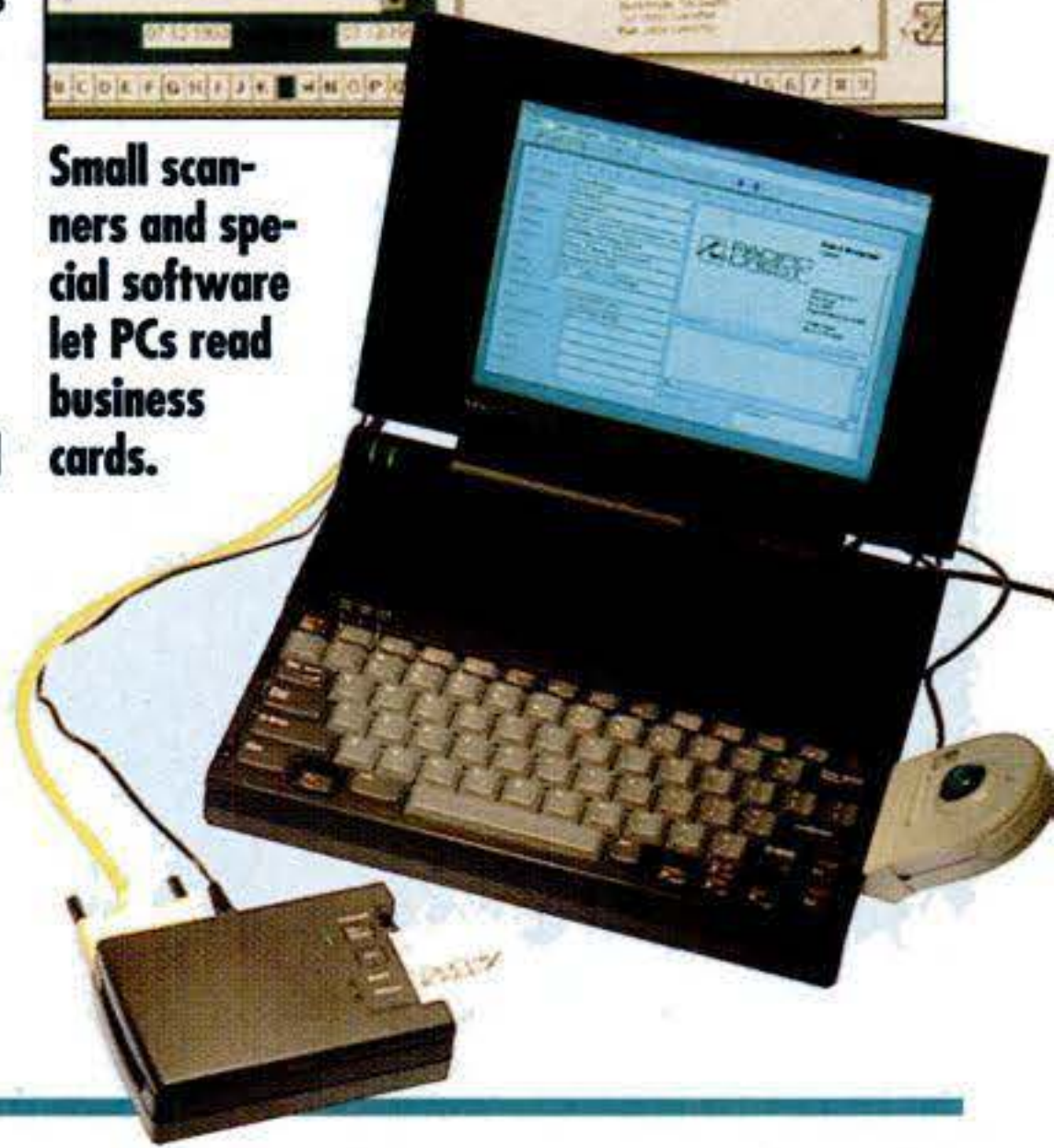
MAY I GIVE YOUR PC MY CARD?

Depending on your personality, you probably organize newly acquired business cards into little piles on your desk or painstakingly enter the data into your PC. Neither method is very efficient, which explains why several companies have recently introduced products for scanning business card data into your PC.

In recent months, at least five card-scanning systems have been introduced, including Microtek Lab's Scan-in-Dex, Pacific Crest's CardGrabber, CypherTech's CypherScan 1000, Cognitive Technology Business Card Reader, and Corex Technologies' CardScan. Prices range from \$100 to \$400. You scan the business cards using either the included scanner, or with predesigned templates and your own scanner. The software then saves a graphic representation of the card and uses optical character recognition techniques to read the card and place the data into appropriate database fields.—*Suzanne Kantra*



Small scanners and special software let PCs read business cards.



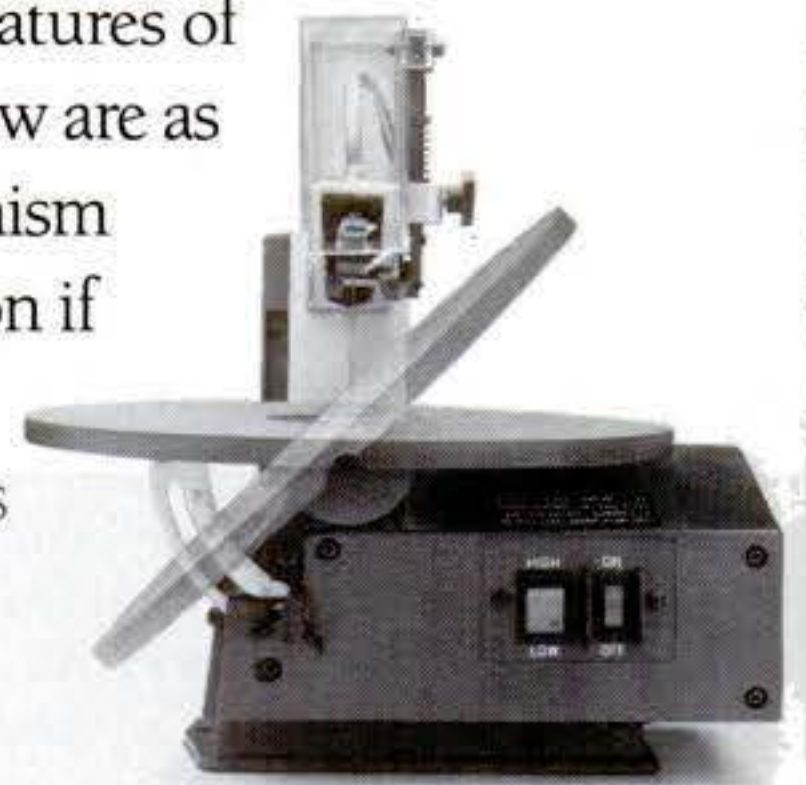
What it takes to cut it as a Consumers Digest Best Buy.

You don't get named a *Consumers Digest* Best Buy without working at it. You have to be an *outstanding* value. That's the Dremel 1671 Scroll Saw.

The Dremel 1671 has a lot of features that make it a pleasure to use. It has two cutting speeds and a powerful motor that lets you buzz through wood up to two inches thick, as well as sheet metals and plastics.

The sturdy, 12-inch cast aluminum table is adjustable from 0° to 45° for accurate bevel cuts up to 1-inch thick.

Of course, not all the features of the Dremel 1671 Scroll Saw are as obvious. A special mechanism quickly stops cutting action if the blade breaks. And the heavy cast-iron base keeps vibration to a minimum.



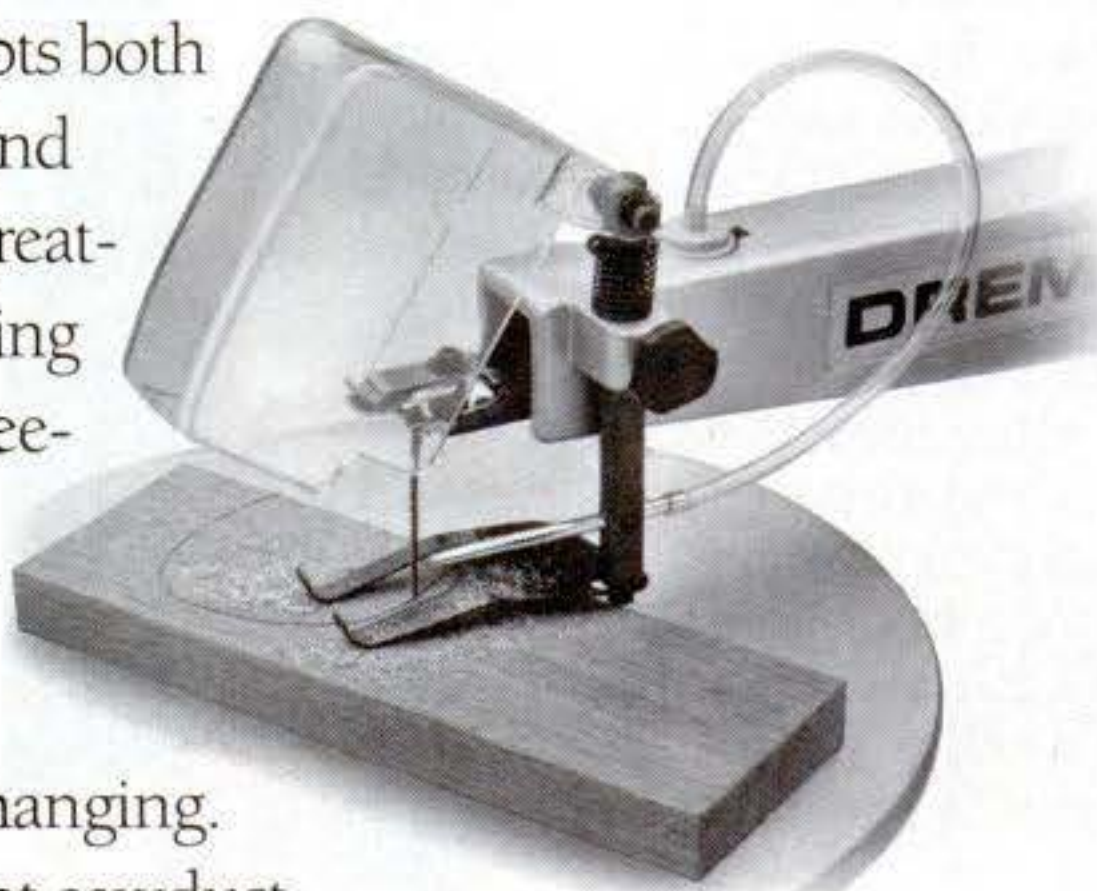
So if you're searching for the perfect scroll saw for your craft or other woodworking projects, check out the Dremel 1671.



A 16-inch throat and the ability to cut from both the front and the side, means you can handle large work pieces.

The saw accepts both plain- and pin-end blades, for the greatest possible cutting versatility. The see-through blade guard pivots out of the way for easy blade changing.

And a convenient sawdust blower keeps your cutting line clear for accurate cuts.



And see why *Consumers Digest* placed it a cut above the rest.

For a free copy of the *Dremel Scroll Saw Blade Application Guide* write to: Dremel, Dept. S-PS, P.O. Box 1468, Racine, WI 53406-1468.

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HOME TECHNOLOGY

EDITED BY SANDY FRITZ

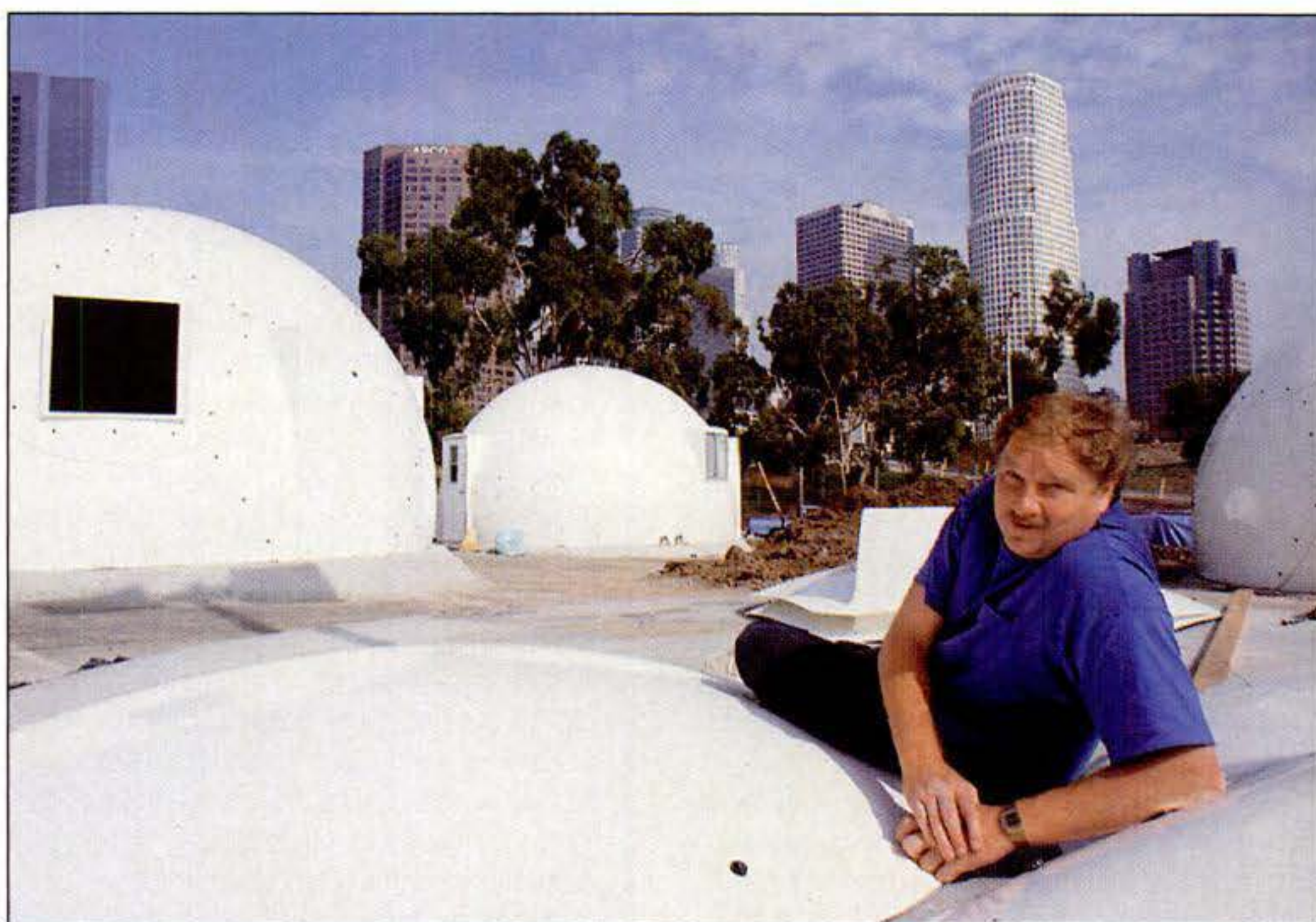
TEMPORARY SHELTERS

HOME SWEET DOME

Ted Hayes has a vision: humane, temporary housing for the homeless of Los Angeles. "Homeless people need individual private space to get their lives together," he says.

Dubbed Project Genesis I, the manifestation of Hayes's vision will house 24 people in 12 domes; six additional domes will contain shared spaces such as kitchens, laundries, bathrooms, a dining area, and an office. Dome residents will eventually be employed by the nonprofit Justiceville/Homeless USA of Los Angeles.

Designer Craig Chamberlain, head of American Temporary Housing in Los Angeles, based the 12-foot-high, 20-foot-diameter structures on the geodesic domes designed by the late



© CHRIS MARTINEZ / GAMMA LIAISON

Craig Chamberlain's domes provide temporary housing for the homeless in Los Angeles.

scientist and futurist R. Buckminster Fuller. One-eighth-inch-thick fiberglass panels overlap like shingles to form the domes. Each dome costs about \$6,500 and was assembled on-site in about an hour and a half by the people who will live in them. Solar panels provide electricity.

The pilot project, located on a one-acre site in downtown Los Angeles, is

the first to comprehensively address the problems of Los Angeles' long-time homeless, claims Hayes. He hopes the effort will lead to a larger encampment within Los Angeles, and will encourage more domes for the homeless in other areas. "I'd like to see whole new cities that the homeless will build, run, and work in."

—Mariette DiChristina

AUTOMATION

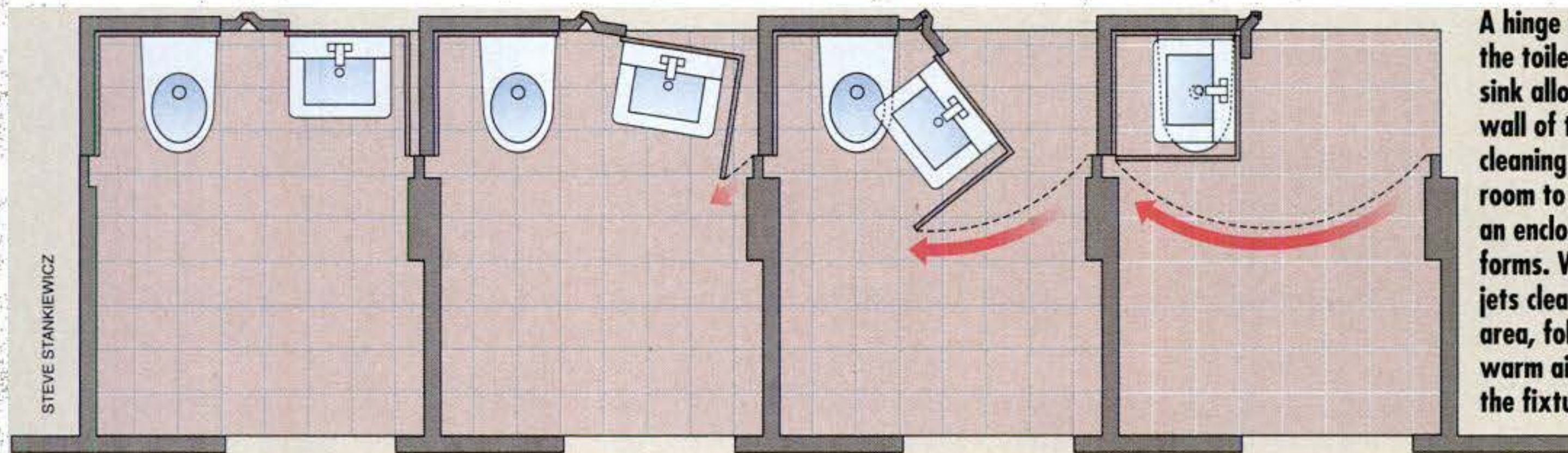
PUSH-BUTTON CLEANING

As a systems engineer and architect working for several major oil companies in the 1970s, Glenwood Garvey heard plenty of restroom horror stories. He decided the solution to the problems was to make a bathroom that cleaned itself.

Garvey, now president of Self-Cleaning Environments in Santa Monica, Calif., builds a bathroom that is quite different—in two key ways—from the self-standing, self-cleaning public lavatories common in Europe: It is designed as a permanent fixture and becomes a closed box when, with the push of a button, a bathroom wall pivots inward. Then, 39 strategically placed nozzles are activated to spray nontoxic detergents and water at the

walls, mirror, sink, and toilet. Paper towels and bathroom tissue remain dry, since they are placed outside the self-cleaning area. Following the washing, warm air dries the walls and fixtures. The total cleaning time is 24 minutes. "It's more sanitary than the conventional way of cleaning a restroom," Garvey says.

Amoco has been testing Garvey's self-cleaning bathroom for about seven months at two gas stations in Illinois and Indiana. "They're actually exceeding our expectations," says a pleased Howard Miller, public affairs advisor for the oil company, who adds that gas station attendants at the two sites actually argue over the privilege of cleaning the bathrooms. Amoco plans to continue their evaluation by adding two more self-cleaning bathrooms in the Chicago area in the near future, at a cost of about \$20,000 each. The technology should be available for homes and condominiums within three to five years.—Joseph Baneth Allen



A hinge between the toilet and the sink allows the wall of this self-cleaning bathroom to pivot so an enclosed box forms. Water-jets clean the area, followed by warm air to dry the fixtures.

WINDOWS

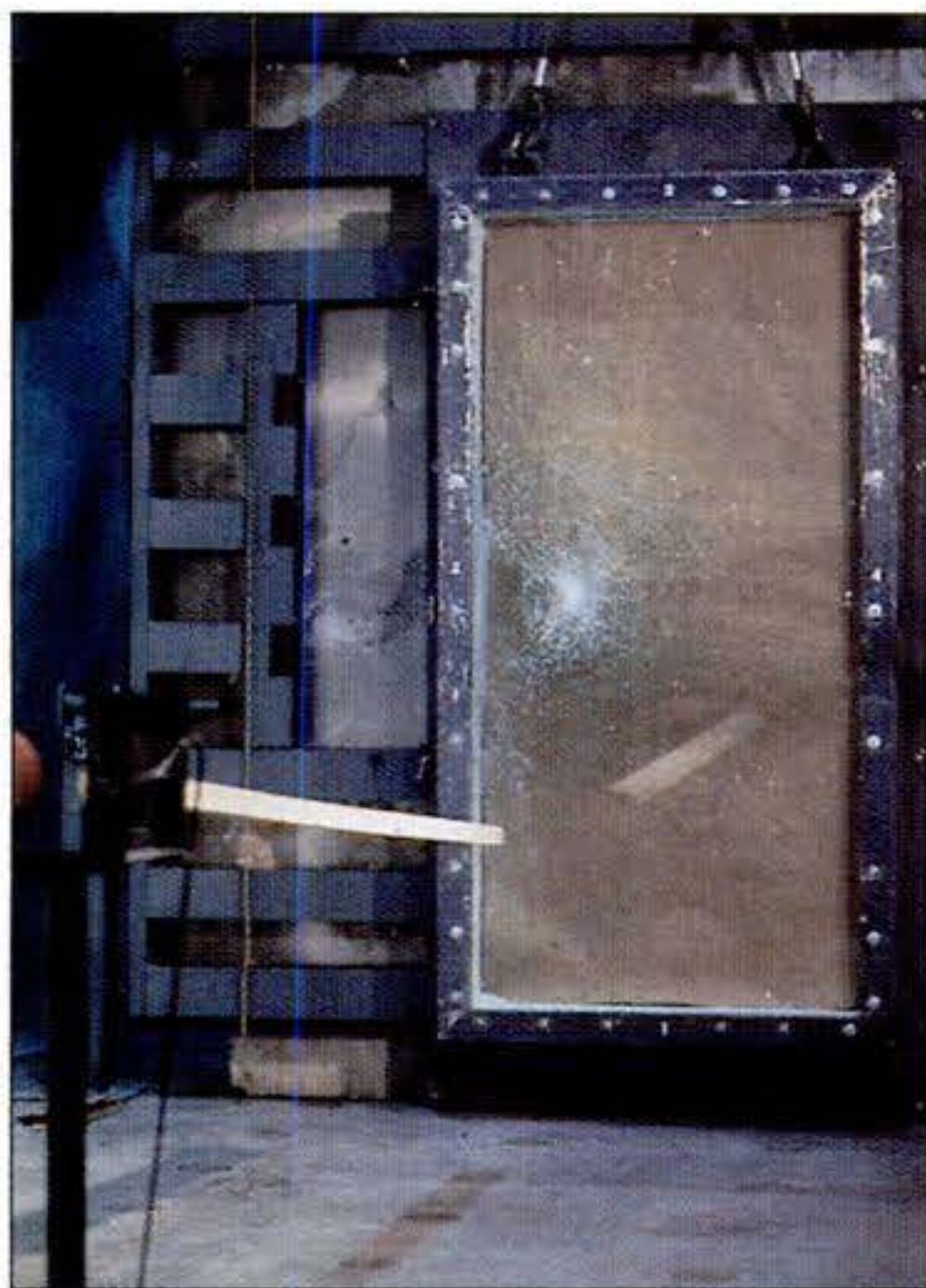
NEW POWER FOR
STOPPING HURRICANE
DAMAGE

Sure, you can see through them, but windows in hurricane-prone areas also serve a more critical function: Built correctly, they prevent raging winds from tearing the inside of a house asunder.

In a preemptive strike against the next hurricane, standards for windows and storm shutters are being revised. To meet the new standards, windows will need to resist impacts from flying debris.

Storm shutters can do this job, but laminated glass offers homeowners a key advantage: It remains in place. "After laminated glass breaks, it holds together—so you won't have a hole in the building," explains Paul E. Beers, president of Glazing Consultants in North Palm Beach, Fla.

Texas Tech Glass Research Laboratory in Lubbock torture-tests windows for hurricane resistance. In work funded by window-film maker Monsanto Co. of St. Louis, researchers first shatter a window with a hunk of wood, which is fired at the glass twice at 35 or 55 mph (depending on design needs). In some cases, the glass is pummeled by 30 small ball bearings shot at 88 mph. The window is then subjected to 18,000 inward and outward pressure cycles that mimic hurricane-wind effects. One finding: To prevent flying shards, the window glass must be anchored to the frame with silicone.—*M. D.*



PEST PROFILE

FLEAS: A CHEMICAL-FREE
SOLUTION

Insecticides effectively kill the fleas that live on cats and dogs, and they're generally safe if used properly. But some pet owners would prefer not to spray their pets with toxic solutions or "bomb" their homes with chemicals. For these people, a new flea trap offers some relief from the biting bugs.

Invented by Kansas State University veterinarian Michael Dryden and two KSU entomologists, Alberto Broce and Kent Hampton, the trap uses light to lure fleas to an adhesive-coated surface where they meet a death suitable for blood-sucking vermin. Unlike other traps that also use light, the new device emits a green-yellow beam that fleas find particularly attractive; the light is produced by a small bulb behind a filter.

What makes the patented trap work so well is the intermittent cycling of the light: Every ten minutes, the bulb switches off for five seconds. "To the flea, it's just like a shadow," says Dryden. Fleas jump toward the "shadow," mistaking it for a passing pet.

The researchers tested the trap last summer, and caught up to 500 fleas a day in some homes. In lab tests, conducted in an 11-by-7-foot carpeted room, the trap snared 86 percent of the fleas within 20 hours. By comparison, commercially available traps gathered only 12 percent.

The trap is reusable. "All you do is occasionally change the light bulb," says Dryden. The researchers are negotiating with a company that sells pet products, and the new flea trap could be on the market within a year. It will probably retail for \$30 or less.—*Dawn Stover*



DR. MICHAEL DRYDEN

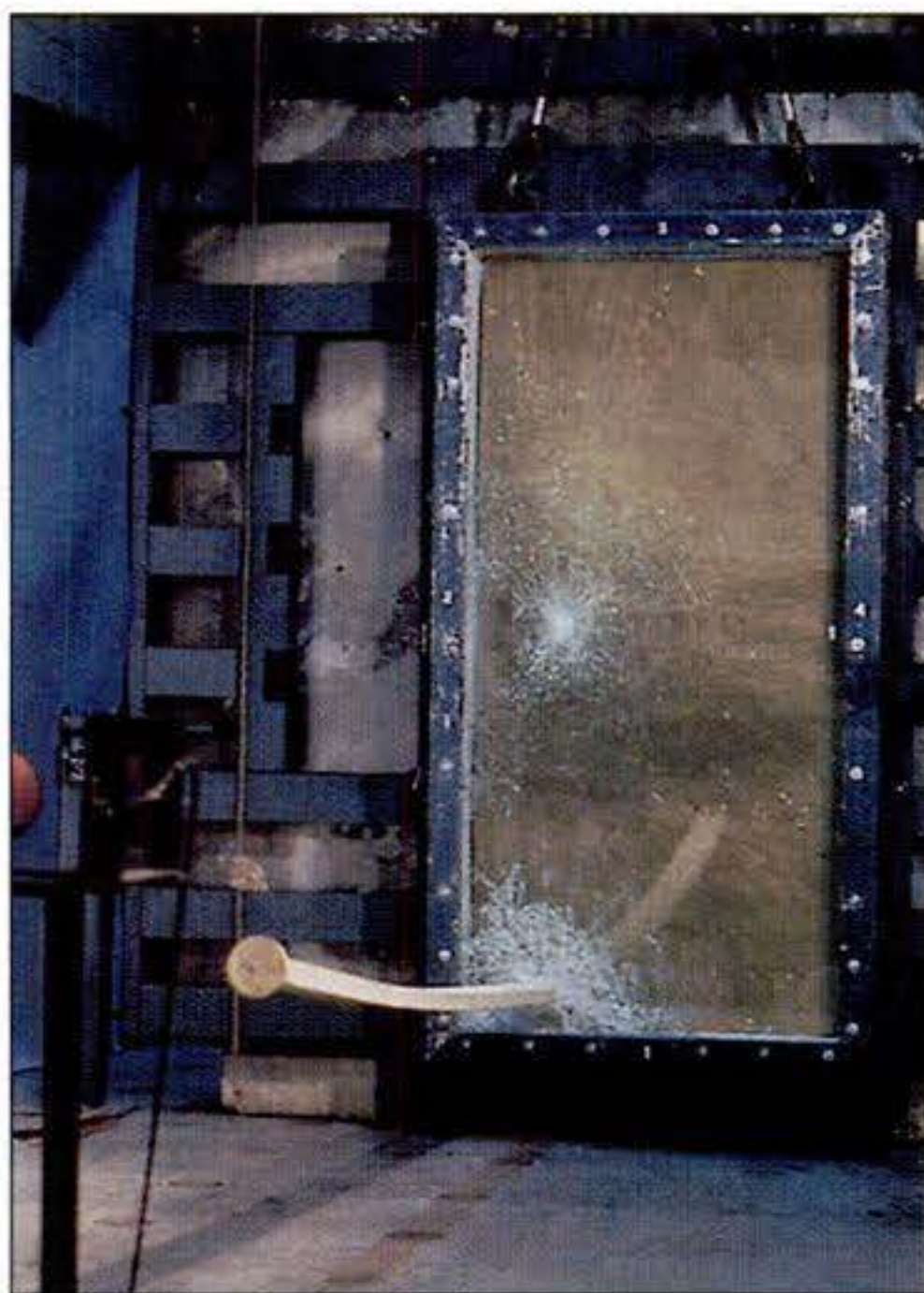
SCIENTIFIC NAME: *Ctenocephalides felis*

COMMON NAME: Cat flea

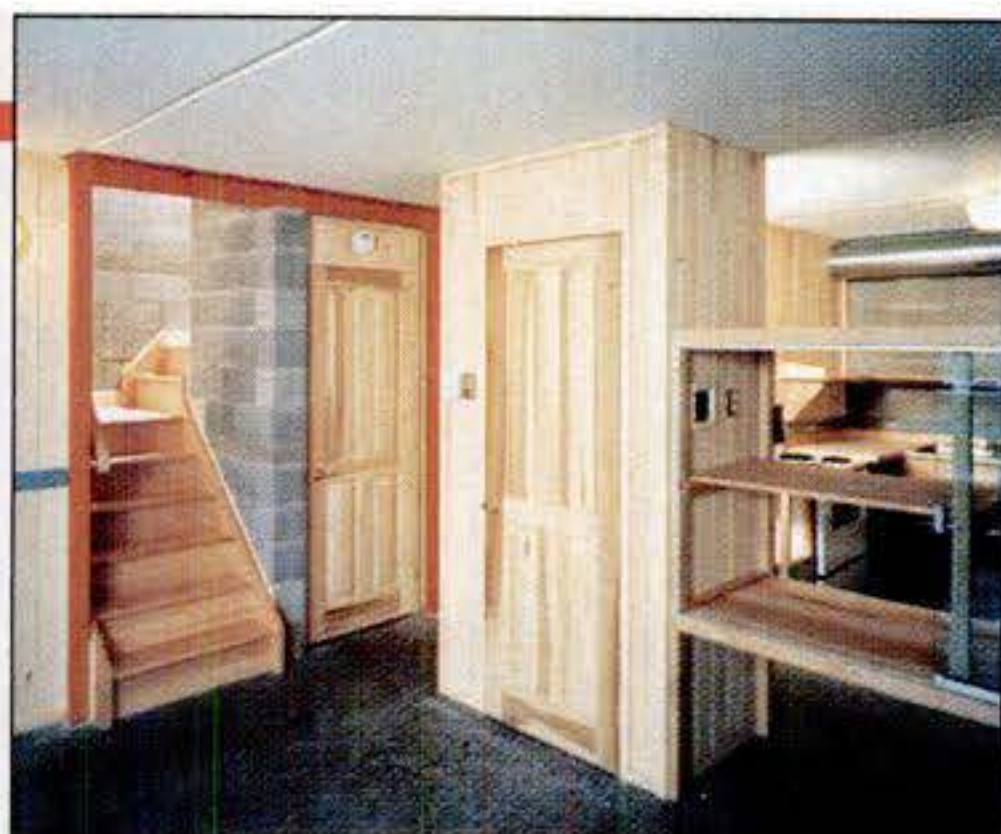
NATURAL HABITAT: The epidermis of hairy animals such as cats and dogs. Also found in carpeting, upholstery, bedding, and lawns.

PESTY BECAUSE: Flea bites leave itchy welts and can trigger allergies. Proteins found in flea feces and debris can also cause allergic reactions, according to recent studies, and it is possible that fleas are responsible for many allergies now blamed on pets. Fleas can also cause skin diseases and anemia, and can transmit tapeworms to cats and dogs.

PROFILE: There are more than 2,000 species of fleas, but cat fleas are by far the most common type found on pets. The flea's life cycle is similar to that of a butterfly: Female fleas lay eggs on a host animal, and the eggs hatch into larvae. The larvae, which feed on flea feces consisting of partially digested blood, spin sticky cocoons from which adult fleas emerge. Newly hatched adults immediately seek a host and begin biting. They mate and lay eggs within two days. During their reproductive period, female fleas consume an average of 15 times their body weight in blood daily.



Ready, aim, fire: In laboratory tests, a nine-pound two-by-four fired at high speed shatters—but fails to breach—window glass laminated with Monsanto's Saflex plastic interlayer. The research tests windows that resist flying debris turned into house-impaling missiles by hurricane-force winds.



Home clean home: No chemicals found here.

CONSTRUCTION

HEALTHY HOUSING FOR THE MASSES

In Barrhaven, Ontario, so-called healthy housing—that is, safe for people who are hypersensitive to many chemicals common to most building materials—has finally moved from the custom-built home market to the realm of affordable dwellings.

"This is the first project of its kind in North America," says builder Oliver Drerup of Drerup Armstrong in Carp, Ontario. Seven energy-efficient units use no materials that can release harmful vapors, such as particle-boards that contain adhesives. Fabrics and carpets, which can harbor allergy-causing dust mites and mold, are avoided as well. Also, carefully controlled ventilation exhausts any pollutants that might otherwise accumulate. The nonprofit project is part of a 41-unit affordable-housing development.—M. D.

LIGHTING

A BRIGHT IDEA

A new filament under development at Superkinetic Inc., a Santa Fe, N.M., research company, could revolutionize incandescent light bulbs.

Incandescent bulbs currently use metallic filaments to create light, but these filaments become brittle with age and eventually burn out. Superkinetic is experimenting with ceramic filaments that would last longer and use less electricity than conventional filaments.

An experimental bulb using filaments of silicon carbide has prompted researchers to look into a related material, hafnium carbide (a very high-temperature refractory material) as their next-generation filament. If successful, these filaments could be easily grown as crystals that would have fewer structural imperfections than their metallic counterparts.

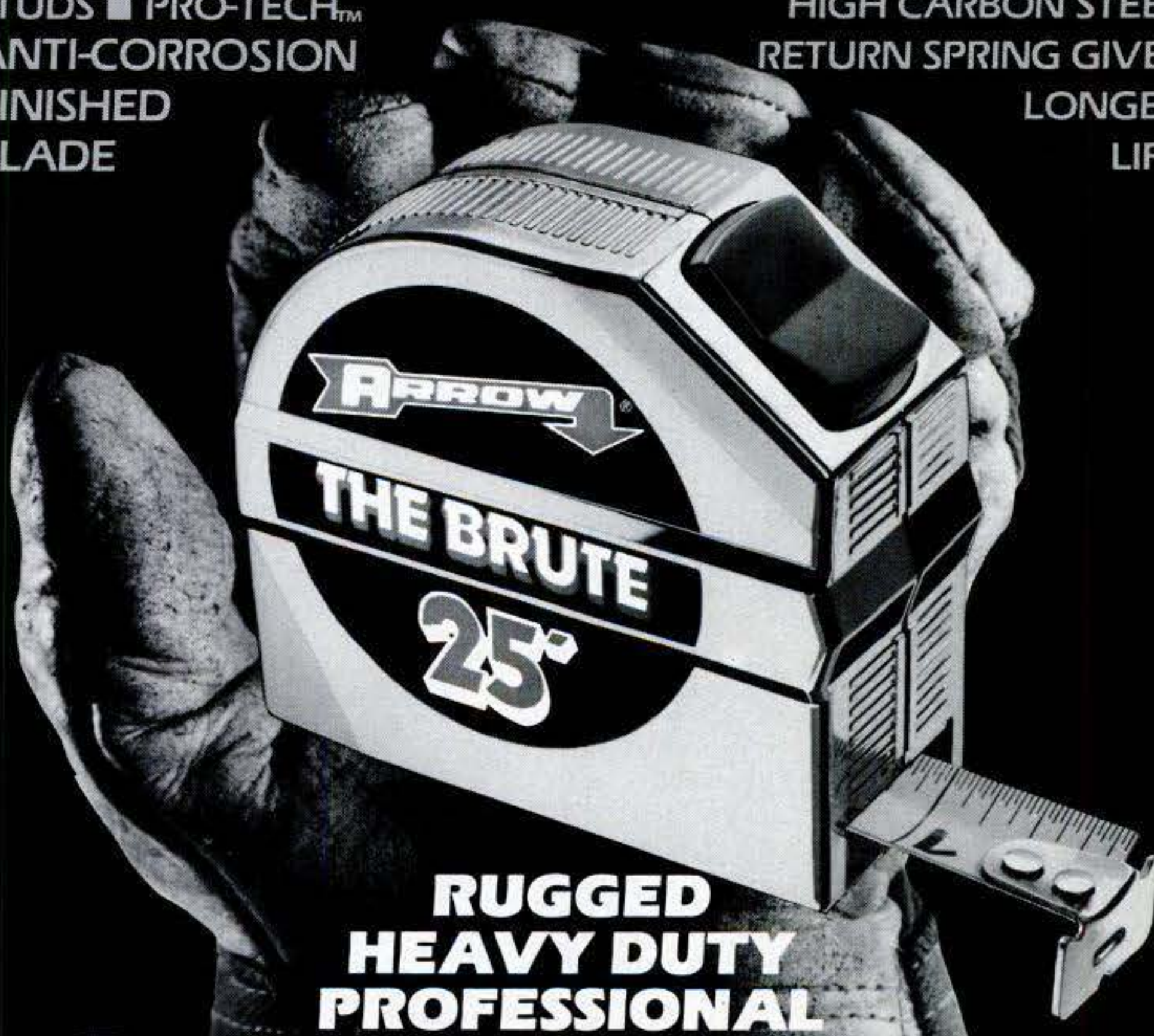
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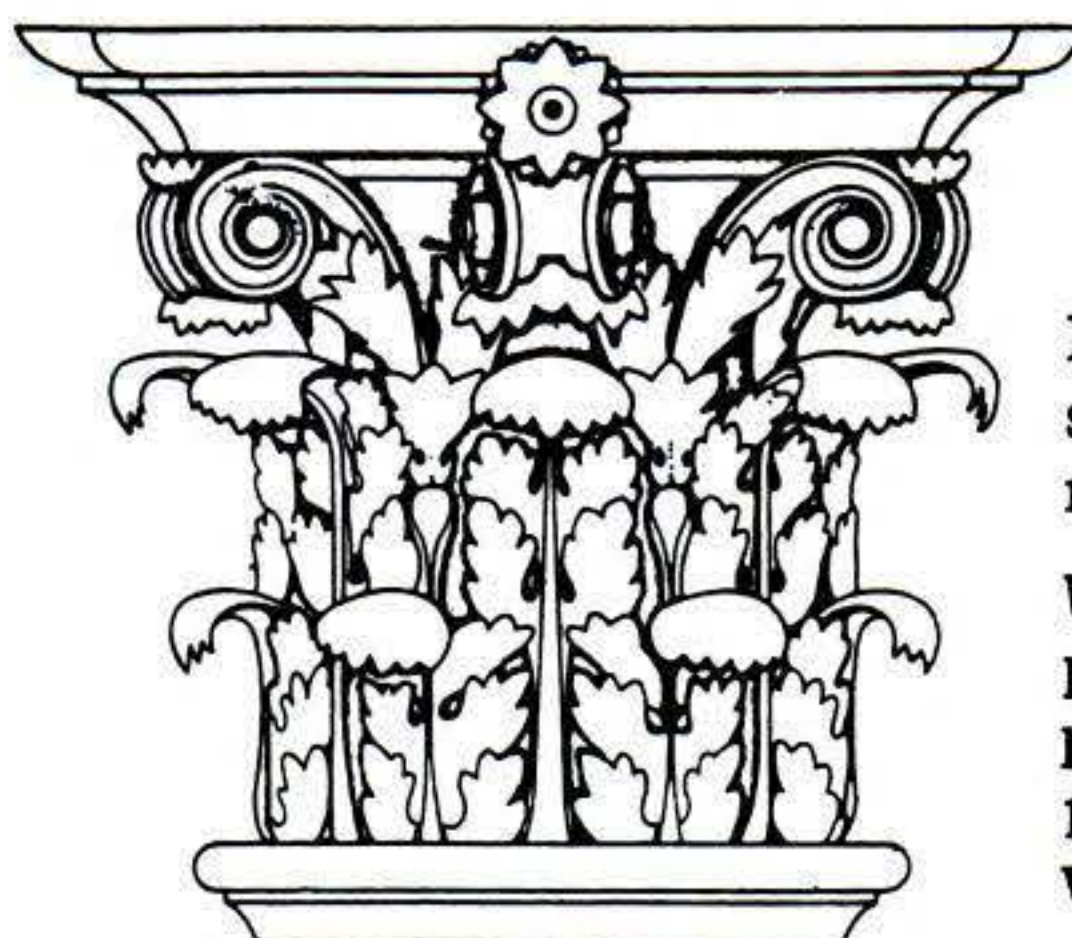


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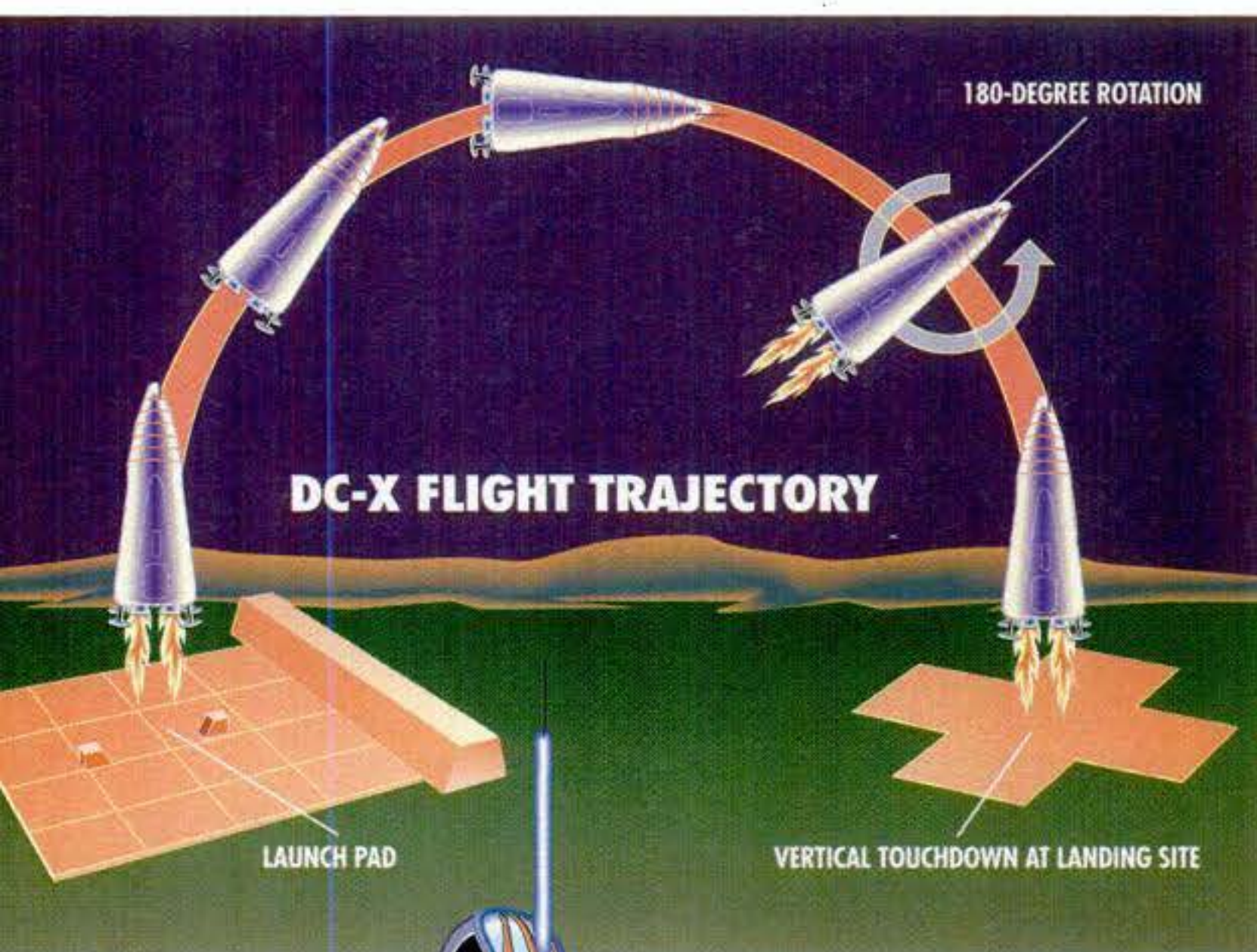
FEBRUARY 1994

New Low- Cost Rides to Space

**A new generation
of launch vehicles
leapfrogs past
the space shuttle
and today's throw-
away rockets.**

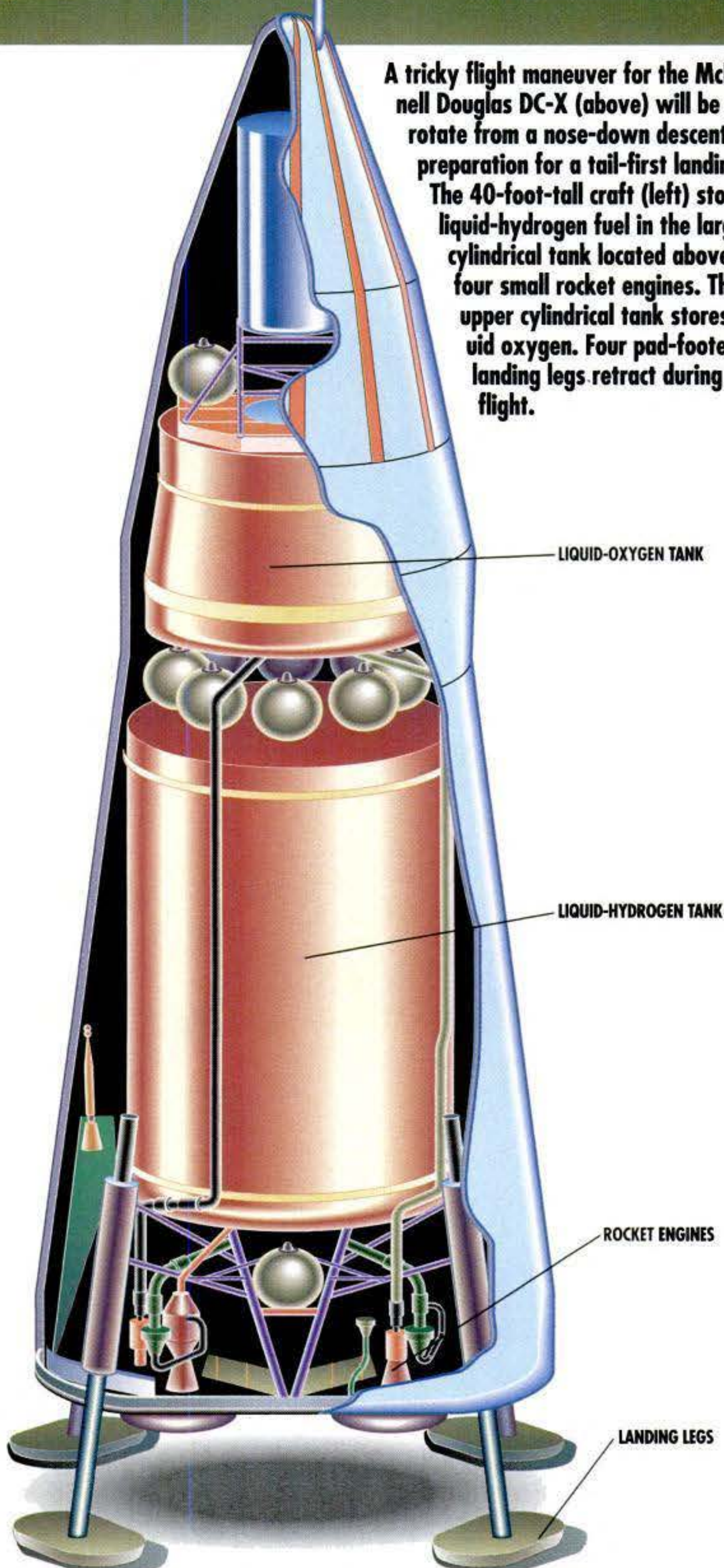
BY STUART F. BROWN

NASA



TECHNICAL ILLUSTRATIONS BY STEVE KARP

A tricky flight maneuver for the McDonnell Douglas DC-X (above) will be to rotate from a nose-down descent in preparation for a tail-first landing. The 40-foot-tall craft (left) stores liquid-hydrogen fuel in the large cylindrical tank located above its four small rocket engines. The upper cylindrical tank stores liquid oxygen. Four pad-footed landing legs retract during flight.



Blasting off from the shimmering gypsum flats of the Army's White Sands Missile Range in New Mexico last September, the McDonnell Douglas Delta Clipper Experimental rocket, or DC-X, rose skyward to an altitude of 300 feet, then slowed to a startling, motionless mid-air hover—as if it were a helicopter. Tilting slightly, the craft next flew sideways for 350 feet. Finally, it began to descend tail-first. Telescoping legs with disk-shaped feet quickly extended, and the rocket used a fiery burst from its four small engines to slow down for a gentle landing. Time aloft was 66 seconds. At the strange craft's touchdown, whoops and cheers erupted from the several hundred onlookers.

Perhaps it does look like something out of Flash Gordon, a bit like a flying gumdrop. No matter. The DC-X has space scientists and engineers more excited than they've been for years. The reason: It could be the harbinger of a first in spaceflight—a truly affordable ride to orbit.

An entirely new generation of economical launch vehicles will be needed if the United States is to stay in the business of lofting commercial, military, and scientific payloads into Earth orbit and beyond. Space-launch accountants know that the major share of the space shuttle's huge cost—\$500 million to \$1 billion per flight, depending on whose numbers you believe—goes toward the 30,000 people who help keep yesterday's technology in operation.

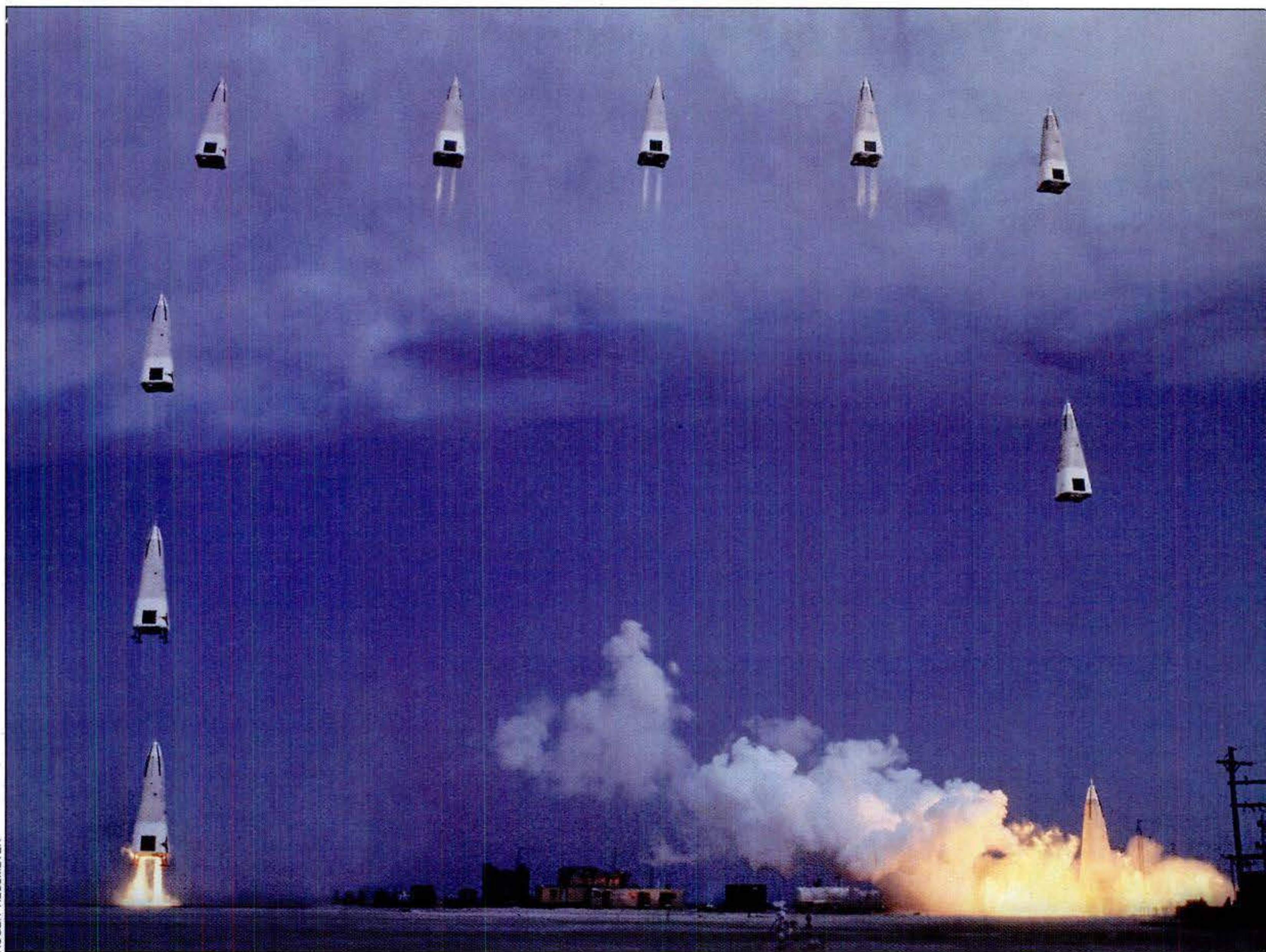
Operating costs are high, too, for the existing range of large, unmanned rockets: the Delta, Atlas, and Titan launchers that evolved from what were originally military ballistic missiles. These rockets have experienced a discouraging spate of failures in recent years, including last summer's \$2 billion explosion of a Titan IV carrying a payload of spy satellites.

Designers hope future craft derived from the one-third-scale DC-X test rocket (one-third the size of a hypothetical craft capable of full orbital missions) or other new launcher ideas being explored will reduce the cost of orbiting a pound of payload to as little as \$500. The government anticipates launching about 39 payloads weighing 25,000 pounds each from 1995 to the year 2030. With the current fleet of rockets, the cost of those launches would add up quickly, at \$3,000 to \$10,000 per pound.

The reusable, single-stage-to-orbit (SSTO) idea represented by the Delta Clipper program has appeal partly because it avoids throwing away expensive hardware, such as the lower-stage engines and fuel tanks used in conventional rockets. But greater cost savings would come from conducting airliner-type operations: Rockets would be serviced, refueled, and quickly relaunched by ground crews that are unthinkably small by current standards. Because it has been built and repeatedly flown, the DC-X is the most visible result of a race to develop a spacecraft that will dominate the world's launch market by getting the job done more cheaply than its competitors can.

Access to Space, a review of the nation's launch-vehicle needs, is being carried out by an interagency group with members from NASA, the Department of Defense, and the Department of Transportation. The team is evaluating several generic advanced-technology launcher designs, including an SSTO rocket, an SSTO air-breathing rocket based on the X-30 national aerospace plane (NASP), and a two-stage-to-orbit (TSTO) combination of an air-breathing first stage and a rocket-powered second stage. It appears that any of the systems could be made to work and could cut space launching costs to 20 percent of their current levels. The TSTO represents a lower-risk, moderate-performance option, while the SSTO concepts are higher-performance alternatives that involve greater technical risks.

In general, the government describes its launching needs



to a group of aerospace firms, leaving them free to develop launch-system proposals based on their individual engineering philosophies and areas of expertise. A winnowing process identifies any technology-development efforts needed to make the most promising ideas work and gets the research rolling. Then an experimental version of the best design is flight-tested and developed into a new national launcher relying on the most advanced technology.

In addition to the Delta Clipper's vertical-launch-and-landing concept, four alternative reusable launcher designs have been proposed. If funding can be found, more than one of these ideas may be developed to see which holds the most promise. They are:

- A winged SSTO rocket that would take off vertically from a launch pad, then glide back for a runway landing. This option carries the extra weight of stubby wings and landing gear rather than the extra fuel a Delta Clipper-style rocket needs to slow itself for a tail-first landing.

- An air-breathing SSTO that would use a small rocket at the end of its runway-based flight to orbit. The ailing X-30/NASP program [see "Whatever Happened to NASP?"] seeks to develop a craft that would avoid the need to carry large on-board supplies of liquid oxygen by using ramjet and scramjet engines burning hydrogen mixed with atmospheric air.

- A vertical-launch, runway-landing, wingless lifting-body design. Lockheed Corp., which is working on the craft, calls it an aeroballistic rocket. The craft's wide aft end would house several rectangular rocket-propulsion units of a type

DC-X IN ACTION

The flight of the DC-X experimental rocket is shown in this multiple image. Takeoff occurs in the lower right-hand corner. A bank of remotely triggered cameras located a few hundred feet from the rocket captured the craft at ten points along its flight path, at approximately eight-second intervals. The ten frames of transparency film were digitally scanned and then composited on a Macintosh Quadra 950 computer. The completed image fills 79 megabytes of disk space, and was transferred onto eight-inch by ten-inch transparency film using a Kodak LVT laser film recorder.

known variously as linear, plug-nozzle, or aerospike engines.

- A runway-based TSTO launcher, which Boeing and NASA have been studying. Boeing's concept uses a large mothership powered by advanced jet and rocket engines to carry an underslung, NASP-like orbiting craft. A NASA configuration puts a rocket-propelled orbiter on top of a mothership powered by turbofans and ramjets. A precursor to both is Germany's Saenger, which features a large Mach 6 turbo-ramjet craft with a small rocket-powered orbiter on its back.

Nobody knows yet whether today's technology can make SSTO flight a reality. Going to space is governed by the physics of rocket science, in particular by a rule known as

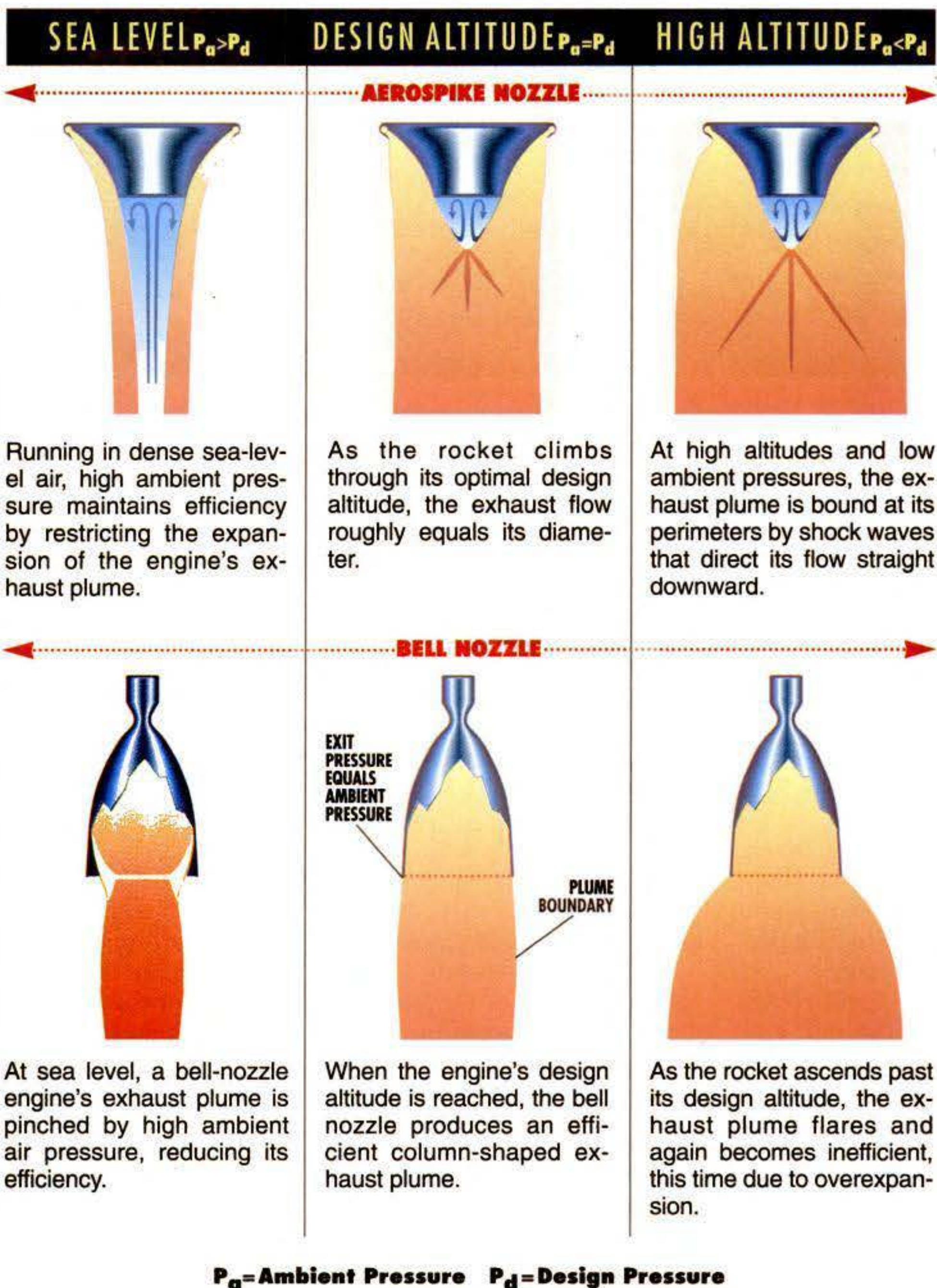
NEW ENGINES FOR NEW ROCKETS

Reusable launchers will need lightweight, highly efficient engines to reach orbit. One candidate is an industrial-strength version of the space shuttle's main engine (SSME). The highly stressed hydrogen- and oxygen-burning Rocketdyne SSMEs are the world's most efficient rocket engines, but they need a major overhaul after each flight to ensure safety. Beefing up the engine's structure, while reducing performance somewhat, could make it reliable for multiple flights without extensive maintenance.

Russia has a contender, too. The "tri-propellant" RD-701 engine built by NPO Energomash is designed to burn a combination of liquid oxygen, kerosene, and liquid hydrogen during the first phase of flight. Kerosene, a dense fuel that produces high thrust to accelerate the fuel-heavy vehicle at takeoff, can be stored in smaller, lighter tanks. During the climb, the engine switches to hydrogen, a fuel that expands into exhaust at higher efficiency because of its much lower molecular weight. The RD-701 has been ground tested, but not yet flown, and needs further development.

A third candidate is the aerospike engine, which replaces the traditional bell-shaped exhaust nozzle with a flat-bottomed inverted cone surrounded by a ring of combustors. A rocket engine's exhaust nozzle controls the expansion of its combustion gases, ideally producing a straight-edged column, and sends the resulting thrust force upward into the vehicle. Bell nozzles produce an exhaust flow that changes shape during flight, as pressure varies from the atmosphere at sea level to the vacuum of space. Thus, the designers must choose a compromise shape that's best at only one point during the rocket's ascent.

The aerospike engine uses shock waves and changing ambient air pressure during the climb to maintain an optimal expansion ratio. "It's an altitude-compensating nozzle without any moving parts," says Rocketdyne director of advanced programs Hank Wieseneck, one of the engine's developers.—S. F. B.



the rocket equation. According to veteran rocket designer Max Hunter, a longtime SSTO proponent and consultant on the DC-X: "The equation says the amount of high-energy propellant you have to carry to reach orbit works out to about 90 percent of the vehicle's takeoff weight, which leaves only 10 percent of takeoff weight for the rocket's structure and payload."

To make room for a useful payload, designers have traditionally built rockets in multiple throwaway stages, each with its own engine and fuel tank. "The only reason for staging was that we couldn't build a light enough structure that could carry all the propellant," says Hunter.

New lightweight materials promise to keep the structural portion of a rocket's takeoff weight low enough so that the craft may be able to lift a payload into orbit with only a single stage. Early aerospace metal alloys used in rockets 20 or 30 years ago have been improved. A weight-saving aluminum-lithium alloy is now available, for example. So are more exotic materials, such as the heat-tolerant titanium metal-matrix composites developed in the NASP program. Modern materials like carbon- and aramid-fiber composites can also be used in interior structures, where temperatures remain in the moderate range.

Using advanced-design rocket engines with high internal temperatures and pressures [see "New Engines for New Rockets"] is the second way designers can push toward meeting the tough goal of fully reusable SSTO rockets. High-performance engine options include a modified version of the powerful space shuttle main engine, a novel "tri-propellant" engine built in Russia, and the promising aerospike design that Rocketdyne and Aerojet have worked on.

McDonnell Douglas was chosen to build the DC-X after a competition in which four aerospace companies submitted designs. The project's \$67 million price was paid by the Ballistic Missile Defense Organization (BMDO, formerly known as SDIO and nicknamed "Star Wars"), which has an interest in promoting research that could cut the cost of launching missile-intercepting payloads. Air Force Col. Simon Worden, BMDO's deputy for technology, has made it clear, however, that the money to build the follow-on rockets needed to prove or disprove SSTO's practicality will have to come from somewhere else.

Hovering, maneuvering laterally, and braking its descent with rocket thrust were critical technical milestones for the 40-foot-tall DC-X, the



The Boeing Company proposes a two-stage-to-orbit (TSTO) launching system that would carry an orbital craft nested in the belly of a mothership (below) to a high-altitude launch point. The mothership Boeing suggests uses

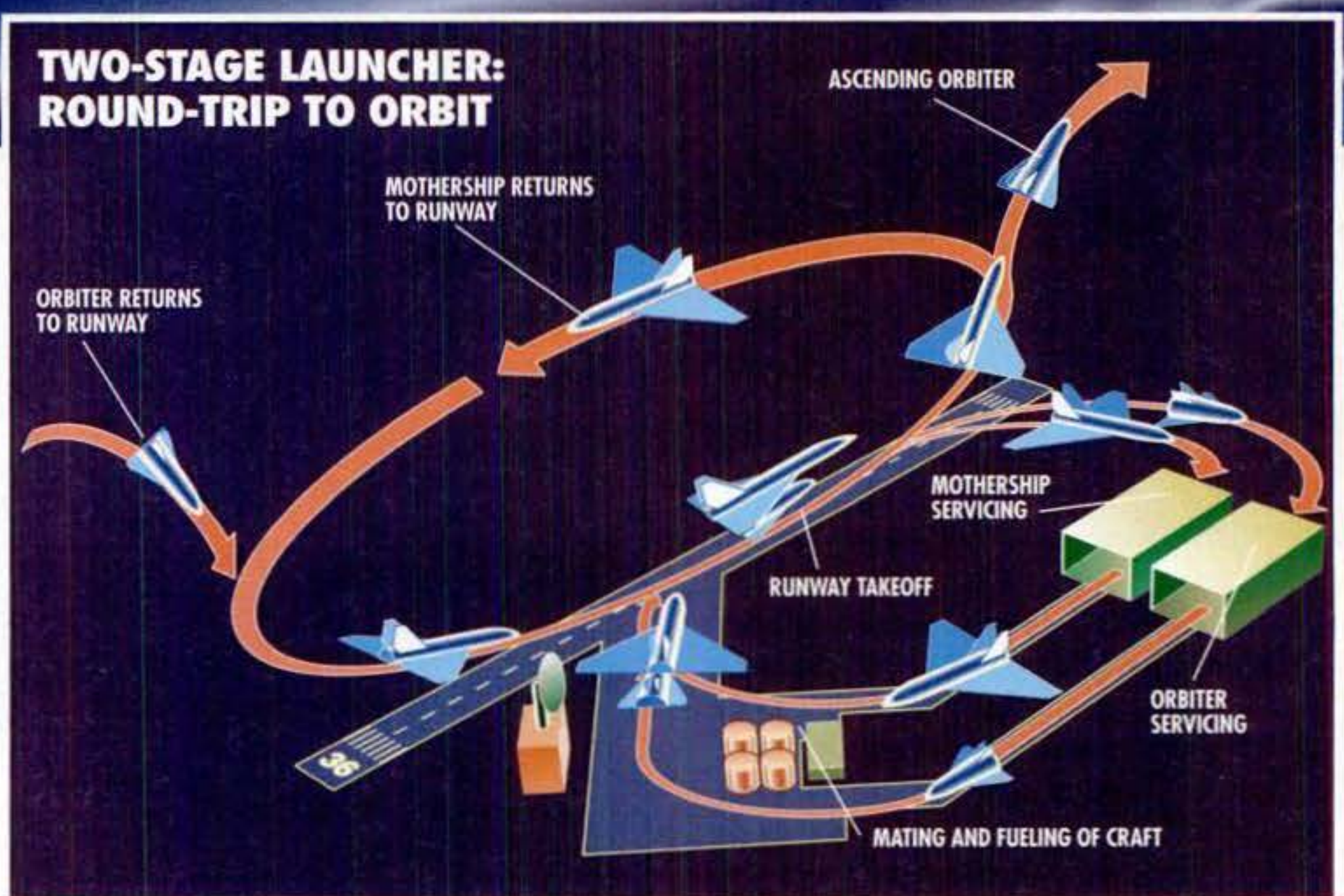


six high-thrust turbojet engines and a single rocket engine borrowed from the space shuttle and mounted between the twin tails. The orbital craft shown at left separating from the first-stage craft is based on the X-30 national aerospace plane design.



Boeing's operational chart (right) shows the servicing, mating, and fueling of the two-stage launch system in preparation for launching from a runway.

TWO-STAGE LAUNCHER: ROUND-TRIP TO ORBIT



product of a program begun barely two years ago. "The bird flies well, and landed right on the center of the pad," reported the flight test manager, former Apollo astronaut Pete Conrad, beaming. "Some of the heat-protective paint turned black, so we'll take the hose and soap and wash it. Then there's no reason not to run it for several more flights to accomplish all the objectives we can with this vehicle."

Further suborbital tests will keep the DC-X airborne longer and take it as high as 16,000 feet. And if someone commits more money, another, larger test craft will be built—the second phase of a three-part effort to build a fully reusable SSTO rocket that can carry people and payloads into space. According to Paul Klevatt, DC-X project director at McDonnell Douglas, "The next step will be a vehicle twice the size of DC-X, which could be flying up to 100 miles—a real space environment—by the summer of 1996." Congress would have to provide several hundred million dollars to build the second-generation test craft, he says.

If the program continues, the technical obstacles will grow more forbidding. DC-X is in the process of demonstrating takeoff and landing, stability and maneuverability, and flight control—directed by a crew of just three, housed in a small, portable operations center. But only about 50 percent of its weight is devoted to liquid-hydrogen and oxygen propellant; its outer body, or aeroshell, is made from a carbon-composite material intolerant of atmospheric heating at supersonic velocities. That limits the first-generation DC-X to airliner-like speeds and altitudes.

One of the goals for a follow-on experimental craft is to use different materials and lighter designs to improve the fuel portion to at least 70 percent of takeoff weight, accord-

ing to Maj. Jess Sponable, DC-X program manager at BMDO. Another, he says, is to demonstrate a thermal-protection system during high-speed, high-altitude suborbital flights that will generate many of the aerodynamic and heating stresses of reentry from orbit. One key maneuver will have engineers biting their fingernails: safely flipping the craft end-for-end from its nose-down reentry attitude

in enough time to fire the rockets for a tail-first landing.

Meanwhile, McDonnell Douglas is looking ahead to a third-generation craft called the DC-Y. A 130-foot prototype orbital rocket weighing about 1.3 million pounds at liftoff, the DC-Y would be able to put a 20,000-pound payload into low Earth-orbit, fly home in one piece, then repeat the feat in a matter of days rather than weeks or months.

NASA, previously unsupportive of SSTD rocket research, has been jolted by the successful DC-X flights into setting up a study called X-2000, which may lead to the development of its own single-stage rocket. Or, the agency might decide to step in and support the continuation of the Delta Clipper effort. Regardless of what NASA does, the Defense Department's Advanced Research Projects Agency and the Air Force, which launches many intelligence and communications satellites, will probably make sure the program doesn't die of starvation.

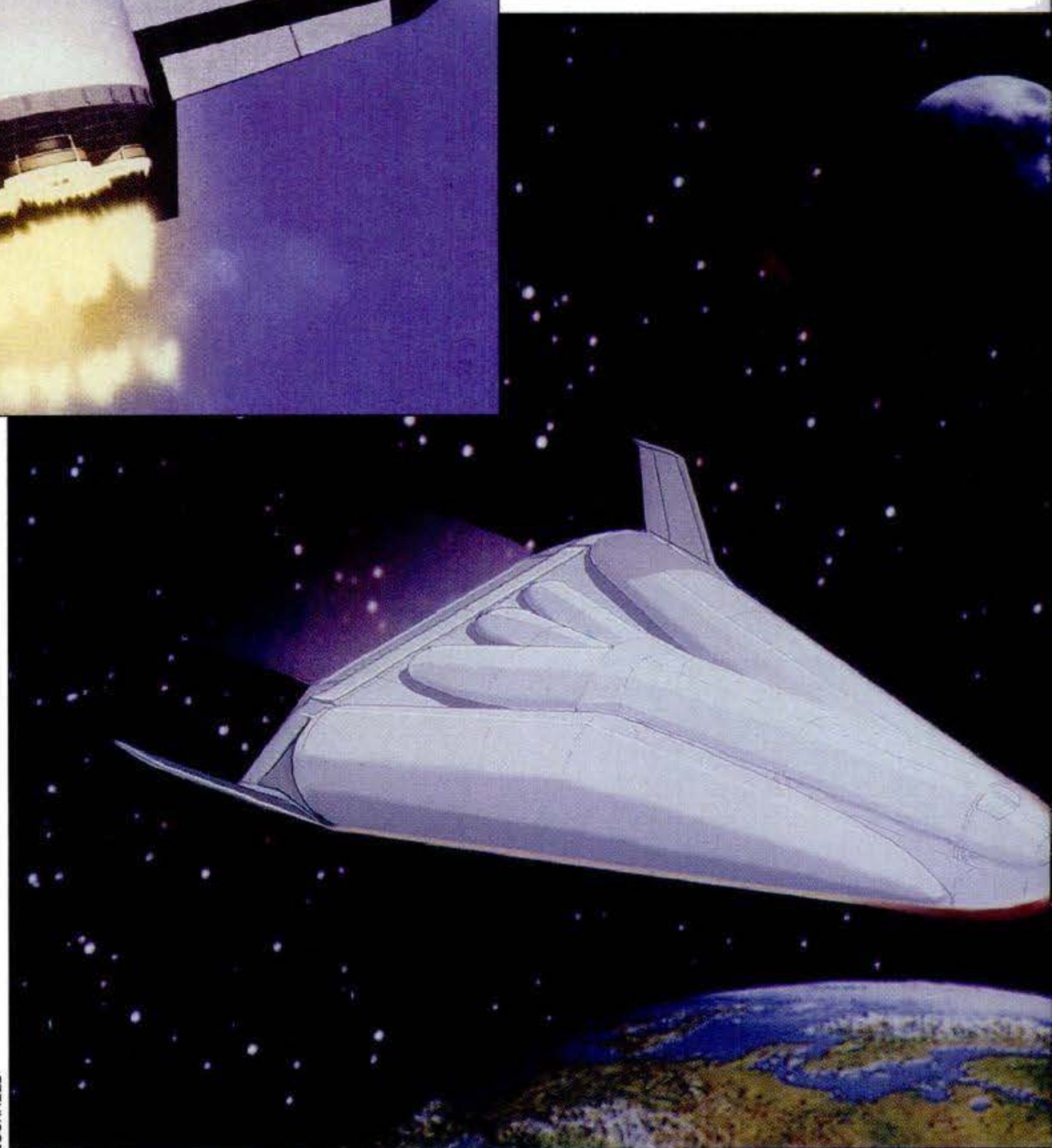
Backers of two-stage reusable launchers, such as the system proposed by Boeing, argue that the design allows for the weight growth that almost all flying craft experience during their development, without demolishing the launcher's payload-carrying ability.

Boeing's idea is to build a large mothership that would sprint briefly from a runway to an altitude of about



NASA's single-stage-to-orbit concepts include a winged rocket (above) that would glide home to a runway landing. Lockheed Corp.'s Skunk Works advanced development group has drafted detailed plans for what it calls an "aerobalistic rocket." With an unpiloted lifting body design (right), the craft would carry a payload matching that of today's Titan IV rocket in the raised area along its centerline. Liquid hydrogen fuel is stored in the bulges on both sides, with liquid oxygen stored in a trident-shaped tank behind the payload. Lockheed isn't releasing drawings showing the linear aerospike engines arrayed across the launcher's aft end.

LOCKHEED



100,000 feet and a speed of Mach 3.3. It would then let loose a NASP-like, ramjet-scamjet-powered orbiter nestled beneath its belly. With that free ride, the orbiter wouldn't have to carry the additional propulsion hardware and fuel needed to accelerate from a dead stop on the ground. The mothership would use advanced jet engines being developed in NASA's high-speed civil transport program. Before takeoff, the two unfueled vehicles would be towed into position by airport-style tugs, then mated and fueled. Both craft would be supported by the mothership's landing gear during takeoff, permitting the orbiter to have extra-light gear sufficient for landing with nearly empty fuel tanks.

"I believe that the NASP isn't going to be able to achieve SSTO," says Richard Hardy, vice president of Boeing's military airplanes division. "We feel the NASP guys should think of themselves as a second stage that starts flying at Mach 3, and let us solve the low-speed propulsion problem for them. About 5 percent of the NASP design's weight is landing gear, and that could be what eats up the payload."

David Urie, Lockheed's director of high-speed and space projects, recalls how the idea for the vertically launched aeroballistic rocket came to him. At the time, he was using a company-developed computer program to generate a series of possible shapes for the Assured Crew Return Vehicle, a proposed craft that would rescue and bring home space station crews in an emergency. Some of the wingless, lifting body shapes generated had a thick and wide aft edge.

"I had an 'aha!' experience when I was looking at one of those shapes, because I realized it was a perfect place to put a row of linear aerospike engines," he says. Using six or seven of the rectangular, high-efficiency engine modules would give the craft the means to fly back to a runway landing even if one or two failed.

The linear aerospike design works on the same principles as a circular, aerospike engine [see "New Engines for New Rockets"]. A concept that has been extensively tested on the ground, it is arranged as a rectangle that ejects exhaust gas through slots at its top and bottom edges. A truncated rectangular spike located between the slots guides the expansion of the gas flow.

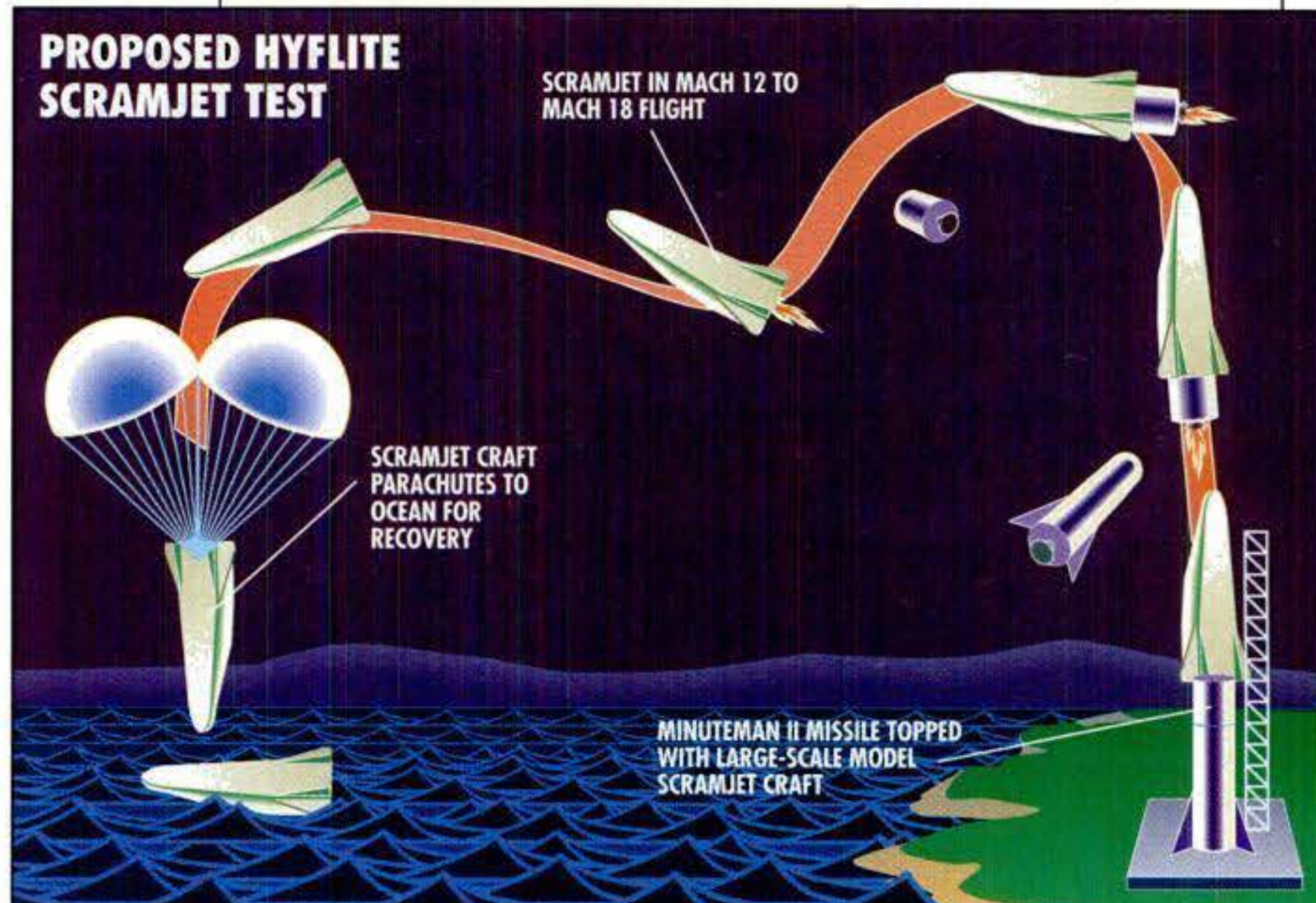
Urie says the linear engines offer weight savings through overall structural efficiency. By feeding fuel into the upper and lower rows of combustors at different rates, the engines can control the craft's pitch angle without the added hardware required to gimbal a conventional rocket engine.

For McDonnell's hoped-for DC-Y to be a winner, the designers must single-mindedly wrestle with the demon of the rocket equation to squeeze in a fuel load accounting for 90 percent of weight at takeoff. Mere grams will count. The engineers know full well that it's better to stay home in bed than let structural weight grow even a sliver of a percent too much—and end up with a rocket that won't make it all the way to orbit, or can't do it with a payload that pays off.

The same harsh equation confronts design teams at Lockheed and any other organization that takes on the SSTO challenge. Is today's aerospace engineering up to it? Maybe two-stage designs—or even a new generation of multistaged, throwaway rockets built with inexpensive, low-tech components—will turn out to be the next way to fly. In the aerospace game, it's nothing ventured, nothing gained.

PS

WHATEVER HAPPENED TO NASP?



One of the most challenging aerospace research efforts ever has been largely discredited and appears to be headed for a crash landing. The X-30/NASP (national aerospace plane) program aims to build a craft that would use an exotic ramjet-scamjet propulsion system. (A scramjet is a ramjet that burns hydrogen mixed with supersonic air flowing through it.) Inhaling atmospheric air, it would fly to very high altitudes and the incredible speed of about Mach 18. Then a rocket would provide the final nudge into orbit.

After several years and an investment of \$2 billion, NASP funding is expected to be cut by about \$20 million in 1994. Useful gains in materials science and other areas have been made, but while an aerospace plane was described and promised, key systems—the engines in particular—are still just laboratory items.

Ben Rich, former president of Lockheed Advanced Development Co. and an expert in high-speed flight, is among those who are skeptical about scramjets. "Nobody has shown me numbers saying that a scramjet has generated net propulsive thrust," after you factor in the steep aerodynamic drag inherent in such engines, he says. The NASP has also met cynicism from overseas. At a 1992 aerospace plane conference, Heinz Pfeffer, head of the European Space Agency's directorate for transportation, said, "NASP is a cover for Aurora [a rumored hypersonic spy plane]. Aurora has achieved its goals and NASP can be allowed to fizzle out."

Nonetheless, some sensible hypersonic testing of technologies needed for the NASP may still take place under a revised research strategy. Jim Mattice, assistant undersecretary of the Air Force for research and engineering, cites a proposed test series called Hyflite [see illustration]. It would culminate in boosting a 30- to 40-foot scramjet-powered subscale test model of an X-30 atop a surplus Minuteman II ballistic missile for a few minutes of Mach 12 to Mach 18 flight. The goal of the six-year, \$2 billion series of nine or ten test flights: reducing propulsion, aerodynamic, and atmospheric-heating uncertainties before building a full-size aerospace plane. One of the conclusions drawn from the Hyflite experiments "could be that this is too hard to do," Mattice says. "But I would say that the chances of the program being successful are greater than 50 percent."

Subscale tests like Hyflite still wouldn't solve the problem of how to flight-qualify a full-size scramjet for service in a manned craft in the same manner jet engines are proven. However, two-stage-to-orbit designs can use a first stage powered by turbofans and ramjets—both well-understood engines. Swapping a scramjet for a ramjet module and flying the craft at its maximum speed would be a way to gain hours of real-world experience. Scramjets and the air-breathing SSTO idea still have backers who believe the potential benefits are too great not to be explored.—S. F. B.

**A look back
at the birth of
Macintosh,
the computer
that changed
everything.**

BY STEVEN LEVY

Surprisingly, in an industry where the term *Renaissance man* is tossed around as casually as a Nerf ball, the man who began the Macintosh project was the real thing. Jef

Raskin had degrees in computer science and philosophy. He was a painter, a musician, and in the mid-seventies, a professor of visual arts at the University of California at San Diego. His next stop was Silicon Valley, where he wrote documentation for the booming personal computer industry. He accepted a position as Apple's director of publications—the company's thirty-first employee—and signed up on the day of the company's incorporation in early 1977.

The personal computer industry had its roots among hobbyists—wireheads and amateurs who were fascinated with the workings of machines. Raskin, though, had a broader vision of what personal computers could be. Computers could empower people—if the computer designers had made intelligent choices. Before the hobbyists even integrated the word into their lexicon, Raskin was a student of interface. He knew that computers were woefully inadequate in how they interacted with human beings. As Raskin put it bluntly: "I think personal computers are a pain in the neck."

The Macintosh, named after Raskin's favorite variety of apple, would change all that. Raskin's alternative, first conceived in 1979, was to create a powerful, low-cost machine that would perform truly useful tasks both elegantly and efficiently.

Apple's Macintosh would be the first computer designed for "the rest of us," the masses previously intimidated by what was then the forbidding technology of impersonal and impenetrable computers. The hope was that the Macintosh would usher in a new era, in which computers could be approached intimately, shattering the barriers between people and information. Over the past decade, the Macintosh has not only become successful in the marketplace, it has also created a discernible impact on the way people work, and even how they think.

Raskin's model for this revolutionary device was a modest yet essential tool: the Swiss Army knife. He kept his ideas about this—his design notes, business plan, marketing concepts, and philosophical musings—in a loose-leaf "Book of Macintosh." In this notebook, he proclaimed, "The purpose of this design is to create a low-cost

*This article is adapted from the forthcoming book *Insanely Great*, © 1993 by Steven Levy, to be published by Viking.*

Insanely GREAT

The original Macintosh

team: Top row; Andy

Hertzfeld, Bill Atkinson,

Burrell C. Smith.

Bottom Row; Steve

Jobs, Jef Raskin,

Susan Kare.



portable computer so useful that its owner misses it when it's not around . . . even if the owner is not a computer freak."

The Macintosh would be a one-piece tool that fit underneath an airline seat. You would flick it on and it would be ready to use. The software for the only really important things you used a computer for—writing, calculating, filing—would be built in. And you wouldn't have to worry about which program you were using: You would simply work, treating the screen like a piece of paper. It would be as friendly to use as a toaster.

With a tentative go-ahead from Apple Chairman Mike Markkula, Raskin recruited a small development team. His key hire was Burrell C. Smith, a diminutive 22-year-old working in Apple's repair department. Smith had little formal training, but when it came to computer hardware he was "The Natural," an instinctive genius. He understood immediately the unique opportunity that Raskin had given him. "It was the one chance of a lifetime to go through the cracks of the corporate culture," Smith has since said.

Smith's questionable pedigree was typical of the Macintosh team, a scrappy assortment of outcasts. (The sole marketing person, for instance, was an MIT-trained anthropologist.) Instead of being handed down to customers from the gods of computer science, the Mac was a bottom-up project, built by the hoi polloi. "We design products that we ourselves want to own," wrote Raskin. His challenge was to maintain his vision during the long struggle of product development. But first he would need a prototype.

Over the 1979 Christmas holiday, Smith attempted to crank out a system that would fulfill Raskin's wish list. For parts, he scrounged around various offices and supply rooms, scavenging whatever seemed useful. For the CPU—the chip that was the

center of all computer commands—he used Motorola's 6809, which was no more powerful than the CPU in the Apple II. In one week, Smith managed to build the main logic board. Early in the new year, he soldered the board into an Apple II box. Before going home that night, he notified a friend in the Apple II division of the project's status. Smith added an informal challenge: Could the programmer get something to display on the screen? Then he would know whether his prototype worked.

The programmer was Andy Hertzfeld, who soon found his way to Smith's desk—and to the prototype. He spent the night trying to conjure a picture on the screen. The image that Hertzfeld chose to display was indicative of the loose frivolity that would eventually become part of the machine's personality: a picture of Scrooge McDuck, underlined with the handwritten greeting, "Hi, Burrell!"

That fall, the group moved out of the main Apple building into an office referred to by the Mac people as "The

Good Earth," named after the health food restaurant that stood in front. There, five workers labored in a single room, with a small anteroom to the side. The team was still hoping to come up with something impressive enough to extend the project in the face of Apple President Mike Scott's wish to scuttle it. That something appeared, but it was not quite what Jef Raskin had in mind.

In a sense, Raskin had only himself to blame for the change. It was he who first

suggested that Apple send a team to visit Xerox Corporation's Palo Alto Research Center (PARC) to view for themselves what was regarded by insiders as the cutting edge of computer technology—the Alto computer and its Smalltalk software system. For years, the PARC wizards, a computer science all-star team, had built upon the ideas of innovative geniuses such as Douglas Engelbart, who invented "windows" on

a computer and the pointing device known as the mouse; and Ivan Sutherland, who pioneered the use of interactive computer graphics. PARC-oids like Alan Kay, the restless visionary who designed Smalltalk, dreamed of ending the era of forbidding, impenetrable computers. By making computers intuitive, they hoped to make the experience an intimate one, accessible to anyone. One look at an Alto screen showed the difference: Instead of fuzzy white or green letters rising from a smoky, black background, the display showed crisp, black letters and sharp graphics against a light-colored display—it was just like a piece of paper!

Smalltalk itself had been designed to be so easy to use that children could master it. You maneuvered your way around the system with a mouse. Pointing and clicking this device could move the screen cursor, select options from a menu, or move through different applications simply by activating a window.

The PARC people had taken a pivotal step in making computers personal, but their bosses had no idea how to put these ideas into the marketplace; the system was languishing in the lab. When Apple called and asked for a formal demonstration of PARC technology, Xerox agreed, but only in exchange for the privilege of buying a million dollars worth of Apple stock. Xerox had no idea that the Apple visit would become a turning point in the history of computers; for Apple it was a heist bigger than the famous Brinks robbery—and it was legal, to boot!

The Apple staffers who visited PARC's hillside headquarters were the designers of the Lisa, a computer calculated to leapfrog over previous technology and maintain Apple's leadership. Many of the Lisa's key engineers and managers had been recruited from established companies like Hewlett-Packard. But a few others, notably a former Raskin crony from the University of California at San Diego named Bill Atkinson, hewed closely to Apple's hacker culture. While Apple cofounder Steve Jobs was most expressive during the PARC visit—"This is revolutionary!" he shouted at one point—it was Atkinson who soaked up the ideas and asked such pertinent questions that Larry Tesler, the PARC scientist who demonstrated Smalltalk, later asserted that no outsiders had ever grasped the system as thoroughly as the Apple people. (In less than a year, Tesler went to work at Apple.)

The drive back to Apple's office lasted only 15 minutes or so, but before it was over, Atkinson and the others



MACINTOSH—YESTERDAY AND TODAY

Compare the original Mac to the base system of late 1993:

ORIGINAL MAC

Screen: 9-inch mono
Processor: 68000
Floppy Drive: 400K int.; 400K ext.
Hard disk: None
RAM: 128K
Printer: Dot-matrix
System price: Around \$3,500

QUADRA 605

14-inch color
25-MHz 68040
Superdrive, 1.4MB
80MB
4MB
LaserWriter
Around \$2,500

In 1984, there was only one Mac—the compact version with a 9-inch monochrome screen and a single disk drive. The only software available was MacWrite and MacPaint. Today a wide variety of models in three distinct families is offered: compact Macs like the Color Classic, modular models like the Quadra and Performa series, and the

Powerbook notebook-sized portables. Most Macs have a color screen, massive storage capabilities, and lightning-fast processors to run the thousands of software applications written for the Mac system. Some newer models have advanced audiovisual capabilities such as built-in microphones, stereo speakers, QuickTime video, CD-ROM players, and—in one limited edition called Mac TV—a built-in cable-ready television. Most amazing of all is the price—all but the costliest Macintoshes are less expensive than the original Mac.

If the automobile industry had similar improvements in price and performance in cars, we would be buying Tauruses, Accords, and Cherokees that cost well under

\$10,000, get hundreds of miles to a gallon, cruise at 500 mph, and provide legroom for 30 passengers.—S. L.



were discussing how to change the world with the ideas they had just been exposed to at PARC. The Lisa project quickly refocused into integrating the lessons of PARC into a relatively low-cost personal computer. This required reinventing the best ideas they had seen at PARC, making them even more accessible to naive users, and doing it on the cheap. Bill Atkinson wrote some amazing graphics routines, known as Quickdraw, to help make this happen, but the look and feel of the overall system drew upon the talents of dozens of engineers and hundreds of tests on users untrained in handling computers. Innovations sprouted like weeds, and the discussions and user tests honed them into usable features. For instance, the menu bar on top of the computer screen began as a way to cement the "pop-up" windows used at PARC into a single, predictable screen location.

Despite the Lisa's advances, it proved to be a flop in the marketplace. It was too slow, it cost too much, and it lacked something in terms of spirit. But the Lisa holds a cherished place in computer history—as the forerunner to the Macintosh.

In many ways, the Macintosh was a smaller, sleeker, feistier, faster, and

friendlier version of its big sister Lisa. The vision behind the Lisa—creating a computer with windows and a mouse that would allow the user to interact with objects on the screen—infected the Macintosh, by way of Steve Jobs.

Not long after the PARC visit, the brash 25-year-old Jobs had been bounced from the Lisa project. When Jobs discovered Raskin's development group, he decided to refocus the Macintosh into a thriftier version of the Lisa—and, he hoped, a better and faster version. Raskin, of course, would not consider compromising his vision of an ultrasimple, ultracheap Macintosh with Lisa-like features. He even resisted the idea of adding a mouse to the machine. But Raskin soon lost control of the project.

"It was clear that the Macintosh was the most interesting thing at Apple—and Steve Jobs took it over," said Raskin.

Jobs cajoled Burrell Smith into designing a new prototype that would use the same microprocessor as the Lisa's. Smith's virtuoso creation not only cost much less than the Lisa, but it actually ran faster. Consequently, it was only a matter of time before Raskin was driven off the project he had begun. Yet his influence

remains apparent: It was Raskin who provided the original vision of a computer featuring low cost, high utility, and ground-breaking friendliness.

Just about the time that Raskin left the Macintosh project, Andy Hertzfeld arrived. With a business card that read "Software Wizard," Hertzfeld generated computer code with the same passion and creativity as the novelists he read and admired. Hertzfeld went to work on the Macintosh Toolbox, the heart of the system, with a genetic code that would evolve into future Macintoshes. "My job was to decide what of the Lisa to keep," he later explained. "I did it my way, following my intuition."

The Macintosh team implemented interface issues on an ad hoc basis. When disagreements arose, the criterion was not "What would an average Joe like?" but "What do we think is the right thing?" Disputes were often settled by voting. The team's inclination was almost always toward the options that the users would find amusing, or those that simply seemed to have the Macintosh flavor.

New alterations developed in the scroll bars on the side of the windows and on the title bars on top of the windows, along with the addition of a

[\[Continued on page 80\]](#)

CHEVROLET C2500 SILVERADO

DODGE RAM 2500 LARAMIE SLT

FORD F-250 HD XLT

The combined weight of a fully loaded pickup truck exceeds 8,500 pounds, so even the U.S. government assumes that such a truck is unlikely to be moonlighting as a car. But that assumption could be wrong.

Trucks this heavy are exempt from certain emission and fuel-economy standards that shackle light-duty trucks, encouraging the use of medium-duty diesel engines that produce more pollution but deliver better fuel economy. That benefit, long appreciated by contractors and other commercial users, is now gaining notice from people who haul heavy recreational equipment, ranging from horse trailers to house trailers. Thus, trucks originally dedicated to commercial applications are finding their way into suburban garages, where they're judged by many of the same standards as the family car.

Ford estimates that perhaps 40 percent of even its largest trucks end up in recreational use, while its lighter trucks are driven even more often in playtime activities. This means that engineering a utilitarian heavy-duty pickup truck requires compromise.

Trying to teach a workhorse truck the manners of a show horse is no

HEAVY

BY

DAN

McCOSH



HAULERS

**Three
turbo-diesel
workhorses
gain a
veneer of
civility.**





The Dodge Ram's dash features oversized buttons so controls can still be operated when you're wearing work gloves. Instrument layout and overall comfort is excellent.



A no-nonsense approach to interiors is clear in the Ford F-Series trucks. Round, clear gauges and sparse design earmark this cabin. Expect the F-Series to be revamped in 1995.



Although Chevrolet led the charge to modernize big trucks in 1987, the C2500's boxy styling—inside and out—is now dated. The seats and rectangular gauges could use an update too.

easy trick. A working truck's cargo can approach the weight of its unloaded chassis, while towing loads can exceed three times the weight of the truck itself. More problems arise not from weight, but from the lack of weight. Even a truck pressed into commercial service spends much of its time unloaded, and the stiff suspension needed for heavy loads can make for a spine-jarring ride. It can also cause problems with brake balancing and handling.

Until recently, these fundamental drawbacks were either ignored or melded into the truck mystique that dictated that if it was rough, it was tough. Then in 1987, GM shifted the bias in the other direction with a thorough redesign of its pickups, dramatically improving handling and creature comforts on its Chevrolet and GMC models. In 1992, Ford followed GM's lead with a major redesign also aimed at removing rough edges. Annually, these two manufacturers split sales of more than a million trucks—over 80 percent of all full-size pickup trucks sold. The sole challenge to this two-party system has been Chrysler's Dodge division, which has trailed as a distant third.

Now, however, Dodge has mounted a new challenge to the full-size pickup truck market. The redesigned Dodge Ram pickup, introduced last fall, is the first new full-size pickup from that maker in 22 years. Given the decades that seem to pass between major pickup overhauls, the chance to test a new Dodge pickup against its competitors struck us as literally a once-in-a-generation opportunity.

The testing also gave us a chance to judge how well these heavy workhorses operate in suburban environments. With more and more owners opting for the pulling power and fuel economy of diesel engines, we rounded up the three contenders—the Dodge Ram 2500 Laramie SLT with a Cummins 5.9-liter turbo-diesel engine; a Ford F-250 HD XLT with a 7.3-liter turbocharged diesel V8; and a Chevrolet C2500 Silverado pickup powered by a 6.5-liter, turbocharged diesel V8—to see whether the improvements have made diesel powerplants more palatable to the general public.

A medium-duty diesel engine is a high-torque powerplant that burns fuel more efficiently than a typical gasoline engine, partially because of its high compression and partially because diesel fuel has a higher energy content than gasoline. Diesel engines also entail some significant drawbacks, including noise, frequent clouds of sooty smoke, and starting difficulties in cold weather. In 1994, emission standards for diesel engines tighten; this will lessen the hydrocarbons and particulates that make diesel exhaust so noxious.

There is a certain romance to diesels—their power and their association with long-hauling truckers, plus the ability to keep the engine running outside a truck stop. The aura quickly fades, however, when you consider the current price of diesel fuel: At the pump, we paid about 15 percent more per gallon for diesel than for gasoline, and this offset most of the claimed fuel-economy advantage (about 25 percent) for the indirect-injection Ford and Chevrolet engines. A direct-injection diesel, like the Cummins, is even more efficient, but we didn't observe any improvements in fuel mileage during our tests.

Starting the Cummins-powered Dodge Ram was frequently annoying. When we cranked the engine up on a cool morning, any glitch in its complicated starting procedure produced clouds of white smoke until the engine warmed up. The installation of a catalyst and extensive manifold heating in early 1994 models should eliminate this problem, however.

Start-up was merely the first hint of the problems that stem from civilizing a direct-injection design. A pre-chamber design—favored by Chevrolet and Ford but being phased out by Ford to help boost fuel economy—ignites the fuel in a small combustion chamber in the cylinder head; this softens the clatter of diesel compression. But the Cum-

ACCELERATION

FORD F-250 HD XLT	11.6
CHEVROLET C2500 SILVERADO	11.9
DODGE RAM 2500 LARAMIE SLT	12.6

0-60 MPH IN SECONDS

BRAKING

CHEVROLET C2500 SILVERADO	168
FORD F-250 HD XLT	160
DODGE RAM 2500 LARAMIE SLT	195

60-0 MPH IN FEET

DOUBLE-LANE CHANGE

CHEVROLET C2500 SILVERADO	52.9
FORD F-250 HD XLT	49.5
DODGE RAM 2500 LARAMIE SLT	48.8

MPH

SLALOM

CHEVROLET C2500 SILVERADO	41.2
DODGE RAM 2500 LARAMIE SLT	40.0
FORD F-250 HD XLT	36.5

MPH

mins, with its direct-injection system, produces an extremely loud idle: We measured sound levels of 60 decibels at an idle—louder than many vehicles we test at full throttle. To Dodge's credit, excellent cab insulation makes the noise acceptable on the highway, and a new engine-mount system virtually eliminates vibration. Still, the metallic clacking sound is obnoxious.

At start-up, neither the Ford nor the Chevy produced as much smoke as the Dodge Ram. Realizing that diesels in this size range will have to cut hydrocarbon emissions and particulates by about half in 1994, Ford and Chevy have independently developed electronic injector control systems that keep the air-fuel ratio in balance, and a catalyst to take care of unburned hydrocarbons.

But smokeless start-ups don't come for free. Ford says its engine is about 20 percent less fuel efficient than Dodge's, although in our limited test we were unable to detect this difference. A direct-injection diesel with better mileage will be offered by Ford at midyear. A diesel engine pulling a heavy load should get about 30 percent better fuel economy than the equivalent gas engine, and even higher if it is direct-injected. If long hauls

with heavy loads are part of the daily routine, a diesel is worth considering.

All three engines barely seemed to notice the weight of our test trailer—a 7,000 pound, 30-foot-long Airstream travel trailer. Low-end torque felt so ample that we found ourselves glancing in the rear-view mirrors to make sure the hefty load was still attached. But the differences in pulling power became apparent when the vehicles were timed for acceleration runs. The Ford placed first, followed by the Chevy, while the Dodge finished a weak third. A low-rpm engine, the Cummins red-lines at about 3,500 rpm, making it difficult for the Ram's four-speed transmission to match the torque curve.

The Ford engine's combination of a broader rpm range and significant horsepower proved far more usable, and it handily outpulled the Dodge and Chevy, both when loaded and unloaded. The Chevrolet engine ended up in the middle, which is not surprising considering its lower-rated power; still, it was quieter and smoother than either of the others. Chevy has done the best job of subduing the noise and clatter that comes with a diesel engine, while maintaining good torque ratings.

The Dodge Cummins engine is the crudest installation in the bunch, despite its improvements, and the diesel option seems to hamper rather than help the Dodge Ram, especially since the truck is extremely smooth and quiet when powered by the optional V10 gasoline engine (see sidebar).

Drawbacks aside, the overall length of the Cummins engine is at least partially responsible for the radi-

MUSCLE, GRUNT, AND POWER

The measure of what a modern pickup truck should be has changed rapidly over the past few years. The interior of a modern diesel pickup is no longer just a dry place to sit while you haul lumber in the rain. It should be stylish and as comfortable as a car, though the truck must retain the sturdiness of a tank and the strength of a team of oxen.

Call it muscle, grunt, or power; all of these trucks have it in huge quantities. All display 0-60 mph times that would embarrass virtually any sedan, and all feature enough low-down torque to pull our 7,000-pound Airstream trailer with ease, at least on the level ground at Ohio's Transportation Research Center. The Ford F-250 HD XLT holds a slight edge for its V8 power. The Ford's braking performance was also superior.

The Chevrolet C2500 Silverado represents excellent dollar value and, though it didn't pull as well as the Ford, our test truck displayed unquestionable leadership in all-around maneuverability, the quietness of its diesel engine, and its overall fuel economy of 18 mpg on a 160-mile highway trip. The interior, however, seemed awkwardly laid out.

The all-new Dodge Ram 2500 Laramie SLT has a Cummins turbo diesel and an ultra-roomy cockpit, but its long wheelbase put it mid-pack in most of the maneuverability tests. The diesel-powered versions of our two test vehicles were both noisy and prone to producing clouds of smoke at start-up.

But the Dodge's big-truck design, its modern interior, and its general personality simply overwhelmed all the hard data generated by the other two competitors. This is the one I'd want pulling my Airstream to the lake.—Jim McCraw

cal styling of the new Dodge Ram truck. Both the diesel and gasoline V10 engines are several inches longer than the V8s used by the Ford F-250 and the Chevrolet C2500, and this necessitates a brawny front end. The Dodge Ram is so imposing at rest that it comes as a surprise when you climb into the cab and discover that overall visibility is, if anything, superior to that in most trucks. Short sightlines to the ground, front, rear, and over the rounded front center make the Dodge Ram pickup relatively easy to maneuver in tight quarters. Visibility is aided by the relatively high seat, and

THE VIRTUES OF A BIG ENGINE

Dodge's new V10 perfectly compliments the big-truck styling in its new Ram. The eight-liter, 300-horsepower engine, which produces 450 pound-feet of torque, is intended mainly for specialized commercial applications and heavy towing service. But unlike most heavy-duty V8 options, the Dodge's V10 is actually smoother and quieter than the standard V8.

Unlike the diesel, the V10 wakes up with a touch to the throttle, and a 0-60 time of eight seconds flat places this truck on par with many high-performance sports sedans. In trailer pulling, it reached 60 mph nearly 10 seconds faster than even the top-rated Ford diesel, a testimony to the V10's broad torque band working in harmony with the gearing.

We observed roughly 12 miles per gallon on the highway with the V10, a figure that compares with big-block V8s. The V10 package greatly enhances the tractability of the big Ram, with an engine as quiet as many luxury cars. Dodge's V10 is clearly the best choice for recreational towing, unless extreme distance makes the fuel efficiency of the diesel worthwhile.—D.M.



COUNTING YOUR OPTIONS



VEHICLE/MODEL	ENGINE	HORSEPOWER @ RPM	TORQUE (FT.-LB.) @ RPM
DODGE RAM 2500	5.2L V8	230 @ 4,800	280 @ 3,000
	5.9L V8	230 @ 4,000	325 @ 3,200
	8.0L V10	300 @ 4,000	450 @ 2,400
	5.9L DIRECT-INJECT I6	160 @ 2,500	400 @ 1,750
FORD F-250 HD	4.9L I6	145 @ 3,400	265 @ 2,000
	5.0L V8	205 @ 4,000	275 @ 3,000
	5.8L V8	200 @ 3,800	310 @ 2,800
	7.3L DIESEL V8	185 @ 3,000	360 @ 1,400
	7.5L V8	245 @ 4,000	395 @ 2,400
	7.3L TURBO DIESEL	190 @ 3,000	395 @ 1,400
	7.3L DIRECT-INJECT	210 @ 3,000	420 @ 1,800
CHEVROLET C2500	4.3L V6	165 @ 4,000	235 @ 2,000
	5.0L V8	175 @ 4,000	270 @ 2,400
	7.4L V8	230 @ 3,600	385 @ 1,600
	6.5L DIESEL V8	155 @ 3,600	275 @ 1,700
	6.5L TURBO-DIESEL V8	180 @ 3,400	360 @ 1,700
	6.5L TURBO-DIESEL V8	190 @ 3,400	385 @ 1,700

Note: Engines may not be available for all weight categories.

by the standard 16-inch wheels, which also improve ground clearance. The Dodge cab stretches about five inches longer than either of its competitors, even in the standard cab version; this allows the seat backs to recline and make room for an ingenious set of removable storage bins that clip to the back of the cab. The seats are easily the most comfortable in its class. Instrumentation is clear and readable, and buttons are oversized to accommodate gloved fingers.

A giant-size armrest that divides the front seat of the Dodge Ram pickup turns into a traylike compartment that could hold several frozen dinners or a laptop computer. About the size of a small suitcase, this compartment creates a small desklike area for organizing papers or other stuff. The Dodge Ram pickup also sports an industrial-size cupholder, guaranteed to keep even 24-ounce slush drinks firmly in place.

Interiors for the Ford F-Series trucks were updated in 1992 with a functional treatment. The instrument panel is a straightforward layout with round, clear gauges. The Super-Cab model includes a serviceable rear seat that folds down, creating ample storage space behind the front seats. The 1994 model features a driver's side air bag.

The Chevrolet C2500 is also roomy behind the seats, although neither Ford nor Chevrolet offers the room to recline the front seat in the standard cab—a feature unique to the Dodge Ram. Chevy's rectangular gauges are sometimes a bit confusing and contribute to a less-than-functional interior design. The seats are less supportive than those of its competitors.

When the workhorses were coaxed into a full gallop in our standard pylon tests for slalom and lane changes, substantial personality differences became clear, mainly because of basic differences in suspension design.

The Dodge Ram retains leaf springs at the rear and at the upper and lower A-arm front suspension; this is similar to older Dodge pickups and is the same as the design favored by the Chevrolet C2500. But the Dodge retains its

[Continued on page 78]

POPULAR SCIENCE TEST RESULTS

Chevrolet C2500 Silverado

Dodge Ram 2500 Laramie SLT

Ford F-250 HD XLT

ACCELERATION and HANDLING

0-30 mph (sec.)†	3.5/7.1	3.6/7.2	3.9/7.9
0-60 mph (sec.)†	11.6/27.1	12.6/30.1	11.9/29.6
30-50 mph (sec.)†	4.9/11.0	5.5/11.6	5.2/11.9
50-70 mph (sec.)	8.3	8.5	8.2
Double-lane change (mph)	49.5	48.8	52.9
Slalom (mph)	36.5	40.0	41.2
Road holding	0.72	0.72	0.71

BRAKING

Cold (ft.)	165	165	179
Warm (ft.)	180	195	168
Hot (ft.)	188	209	192

INTERIOR NOISE

Idle (dB)	56	60	54
60 mph (dB)	67	71	67
0-60 mph (dB)	72	76	74

SPECIFICATIONS

Engine	7.3L turbo-diesel V8	5.9L turbo-diesel in-line 6	6.5L turbo-diesel V8
Valve train	OHV, push rods	OHV, push rods	OHV, push rods
Power (hp @ rpm)	190 @ 3,000	160 @ 2,500	190 @ 3,400
Torque (lb.-ft. @ rpm)	395 @ 1,400	400 @ 1,750	385 @ 1,700
Compression ratio	21.5:1	17.5:1	21.5:1
Transmission	4-speed automatic	4-speed automatic	4-speed automatic
Final drive ratio	3.55:1	4.10:1	3.42:1
CHASSIS			
Front suspension	Swing axles, coil springs	Unequal-length control arms, coil springs, antiroll bar	Unequal-length control arms, coil springs, antiroll bar
Rear suspension	Rigid axle, semi-elliptic leaf springs	Rigid axle, semi-elliptic leaf springs	Rigid axle, semi-elliptic leaf springs
Steering gear	Recirculating ball with power assist	Recirculating ball with power assist	Recirculating ball with power assist
Turning circle (ft.)	52.5	45.4	52.9
Brakes (front, rear)	Vented disc, drum; rear ABS	Vented disc, drum; rear ABS	Vented disc, drum; rear ABS
FUEL ECONOMY			
160-mile trip (mpg)	17	16	18
DIMENSIONS			
Wheelbase (in.)	155.0	134.7	155.5
Length (in.)	235.3	224.3	243.4
Width (in.)	79.0	78.4	76.8
Height (in.)	74.3	72.4	70.6
Curb weight (lbs.)	5,750	5,460	5,610
Distribution % (front:rear)	59.0:41.0	62.6:37.4	43.0:57.0
Fuel tank (gal.)	37.2	35.0	25.0
Interior volume (cu. ft.)	62	63	63
Cargo area (in.)	50.5	50.0	79.3

PRICES, PARTS, AND LABOR

Base price	\$18,100	\$16,302	\$18,530
Price as tested	\$26,329	\$25,475	\$25,450
Major options (over \$100)	7.3L turbo-diesel engine, \$3,151; trim and equipment package, \$2,215; automatic transmission, \$924; other options, \$1,939	Laramie SLT package (interior trim, air-conditioning, sound system), \$3,730; Cummins turbo-diesel engine, \$4,142; automatic transmission, \$897; other options, \$404	6.5L turbo engine, \$2,825; automatic transmission, \$890; rear bumper, \$229; other options, \$2,976
REPAIR: PARTS/LABOR*			
Front brake pads	\$102/39	\$ 98/27	\$190/45
Front shock/insert	50/19	48/22	61/15
Alternator	289/19	280/27	177/25
Water pump	188/78	60/27	113/80
Windshield	391/78	260/81	428/95
Headlamp assembly	125/29	78/14	296/20

†Second figure represents acceleration while towing a 7,000-pound travel trailer.

*Labor costs reflect manufacturer's flat-rate time allowance multiplied by typical dealership labor rates per hour.

**Energy conserva-
tion alone cannot
halt the buildup of
carbon dioxide,
so scientists are
looking for ways
to capture and
store the gas.**

SCIENCE GETS THE CO₂ OUT

**Algae grown in a
Japanese laboratory
may help remove
excess carbon
dioxide from
the atmosphere.**



JOHN B. CARNETT

BY DENNIS NORMILE

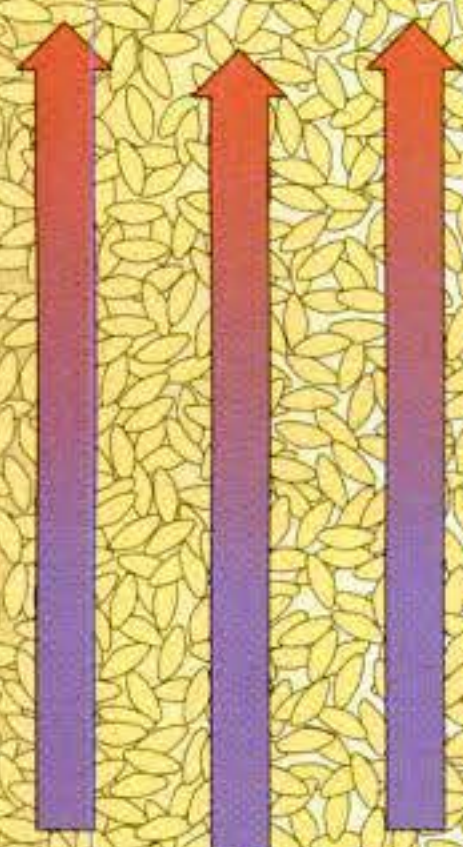
Three years ago, an inexperienced researcher at a laboratory in northern Japan poured two quarts of seawater into a glass vessel, put it under a light, and bubbled a stream of air with a 20-percent concentration of carbon dioxide through the water.

"It was silly," says Shigetoh Miyachi, director general of the laboratory, a part of the Marine Biotechnology Institute in Kamaishi, Japan. The researcher was supposed to be screening organisms tolerant of high carbon dioxide concentrations, but 20 percent was unreasonably high for material pulled from the Pacific Ocean.

ADSORPTION

In one method for capturing carbon dioxide, dehumidified flue gas from a power plant's boilers is fed into a series of large tanks. Each tank holds some 4,400 pounds of BB-sized pellets of a mineral called zeolite. As the gas filters through the pellets, the carbon dioxide molecules adsorb (adhere in a thin layer) to the zeolite. When the zeolite has adsorbed as much carbon dioxide as it can hold, the gas flow is diverted to the next tank. The first tank is depressurized, and the zeolite is heated. This frees the carbon dioxide gas, which is collected and compressed in tanks.

FLUE GAS WITH CARBON DIOXIDE REMOVED



ZEOLITE PELLETS

FLUE GAS

ABSORPTION

This process relies on a chemical reaction in two tall, slender columns. In one, shown below, the exhaust gas flows up from the bottom, while a liquid absorbent, such as monoethanolamine, drips through a succession of internal chambers. The carbon dioxide reacts with the absorbent and is removed from the stack gas, which is expelled from the column's top. The carbon-dioxide-laden absorbent is collected at the bottom and heated in the second column. This reverses the reaction, freeing the carbon dioxide. The carbon dioxide is collected and the re-generated absorbent is recycled.

FLUE GAS WITH CARBON DIOXIDE REMOVED

ABSORBENT

FLUE GAS ENTERS

ABSORBENT CONTAINING CARBON DIOXIDE

"A more knowledgeable researcher would have known better," Miyachi says.

But a few days later, the vessel was filled with a green bloom. An algae, later named *Chlorococcum littorale*, was thriving, taking up the carbon dioxide through photosynthesis. "I was amazed," Miyachi recalls.

The discovery is one of many that may help solve the problem of excess carbon dioxide. The concentration of this gas in the atmosphere is currently rising by about 0.5 percent a year, and is already about 25 percent higher than preindustrial levels. According to some estimates, the amount of carbon dioxide in the atmosphere may double as soon as 2030.

Because atmospheric carbon dioxide, like the glass panes of a greenhouse, traps heat, scientists predict that a doubling of carbon dioxide would increase global temperatures by a few degrees Celsius. That could have a dramatic impact on the world's climate. "We may have already committed the atmosphere to an amount of warming that we may regret later on," says Pieter Tans, a geochemist with the National Oceanic and Atmospheric Administration in Boulder, Colo.

In an effort to curb the amount of carbon dioxide being released into the atmosphere, President Clinton has vowed to reduce emissions to 1990 levels by the year 2000. Other world leaders have also pledged to cut emissions. But modeling studies suggest that natural processes cannot even maintain the atmospheric concentration of carbon dioxide at its current level unless releases are reduced by at least 80 percent. With a burgeoning world population, that seems virtually impossible. Scientists all over the world are beginning to think that efforts will have to go beyond energy conservation to stem the proliferation of carbon dioxide.

The burning of fossil fuels produces vast quantities of carbon dioxide. One day's output from a 500-megawatt coal-fired power plant, if frozen into a cube of dry ice, would measure 50 feet on each side.

But although the amount of carbon dioxide produced by human activities seems huge, it is small compared to the amount already stored in reservoirs such as the ocean, the soil, and terrestrial plant life. That means it is theoretically possible to eliminate the surplus in the atmosphere by engineering a slight shift in the carbon cycle—for example, by channeling more carbon dioxide into the ocean, which already holds 65 times more carbon than the atmosphere.

One problem is that the carbon cycle, though a staple of biology classes,

ILLUSTRATIONS BY JARED SCHNEIDMAN AND GORDON AKERWA / JSD

is still not fully understood. Scientists are puzzled, for example, by the case of the missing carbon dioxide: Fossil fuel combustion pumps between five and six billion tons of carbon dioxide into the atmosphere each year. The clearing and burning of forests adds another one to two billion tons. Agriculture also contributes to the problem: According to a recent study, when soil is cultivated, it loses its ability to store carbon and releases carbon dioxide into the air. The annual increase in the atmosphere from all these sources, however, is only about three to four billion tons. Where does the other half go?

Recent research indicates the oceans and organisms within it are taking up about two billion tons. Scientists suspect that terrestrial plants take up the rest, and some scientists even speculate that higher carbon dioxide levels could boost the growth of carbon-dioxide-absorbing plants, but these are just guesses. "We don't know, really, what is up," Tans says.

He and other researchers fear that whatever is now absorbing atmospheric carbon might reach its capacity or, worse yet, start releasing accumulated carbon, causing a sudden rapid rise in atmospheric concentrations. Tans says action cannot wait for a more complete understanding of the carbon cycle.

Possible solutions to the carbon dioxide problem come in two varieties: the gas may be captured directly from the atmosphere by plants, such as the algae recently discovered in Japan. Some scientists, for example, prescribe a massive reforestation program. Or carbon dioxide may be captured from the flue gases being expelled by power plants and other sources that emit large quantities. After capture takes place, the carbon dioxide must be disposed of, somehow, or it must be recycled into other fuels.

Nowhere is research into such solutions as active as it is in Japan. Government agencies, universities, and private companies there are investigating a variety of schemes for both the capture and the disposal of carbon dioxide. Among their ideas: sequestering carbon dioxide in living organisms; pumping carbon dioxide to the bottom of the ocean; or catalytically converting it into carbonaceous fuels such as methane. These "carbon fixation" schemes face daunting technological and economic challenges, but are considered worthy of investigation because the carbon dioxide

BURIAL AT SEA

A floating power station is the centerpiece of an audacious Norwegian scheme for carbon dioxide disposal. Proposed by the Norwegian Petroleum Technology Research Institute, the floating station would be moored over an offshore oil or gas well that fuels the on-board generating plant. A submarine cable would transmit the electricity to land, while carbon dioxide separated from the engine exhaust would be compressed and injected back into the seabed reservoir to displace the oil or gas. That would not only get rid of the carbon dioxide, but would also boost fuel recovery from the well.

"Oil and gas reservoirs have proven to be safe storage places for high-pressure fluids for millions of years," says Erik Lindeberg, senior researcher at the Norwegian Petroleum Institute. "And it's been estimated that about two-thirds of the carbon dioxide formed by the combus-

tion of the world's petroleum could be stored in their corresponding reservoirs."

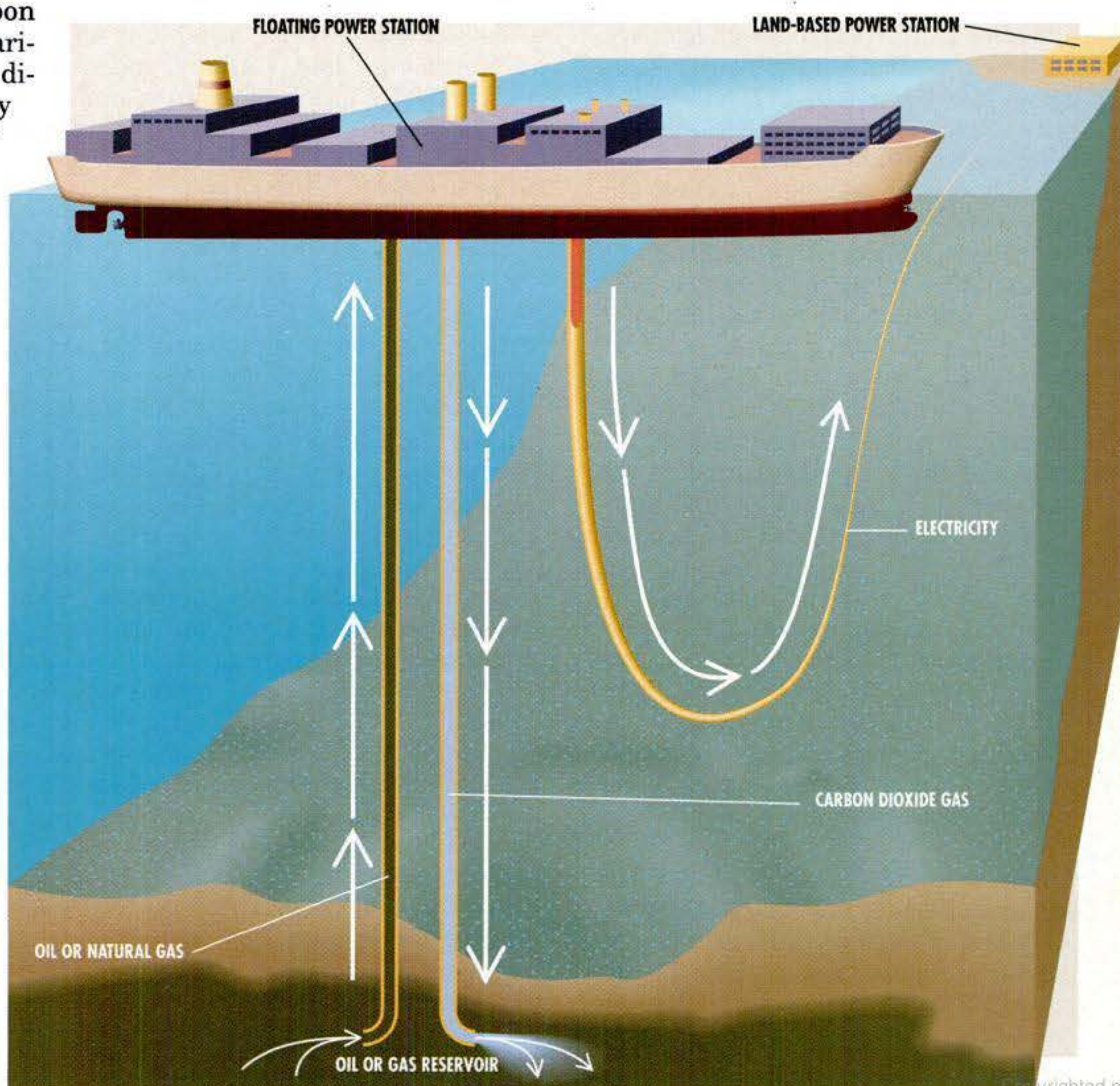
Lindeberg sees carbon dioxide as a suitable injection gas for wells, because it is highly soluble in oil and thus reduces the oil's viscosity. The thinned oil releases thicker deposits that might otherwise be trapped in rock pores. With carbon dioxide injection, Lindeberg figures there could be a 50-percent net gain in the oil extracted from a given well.

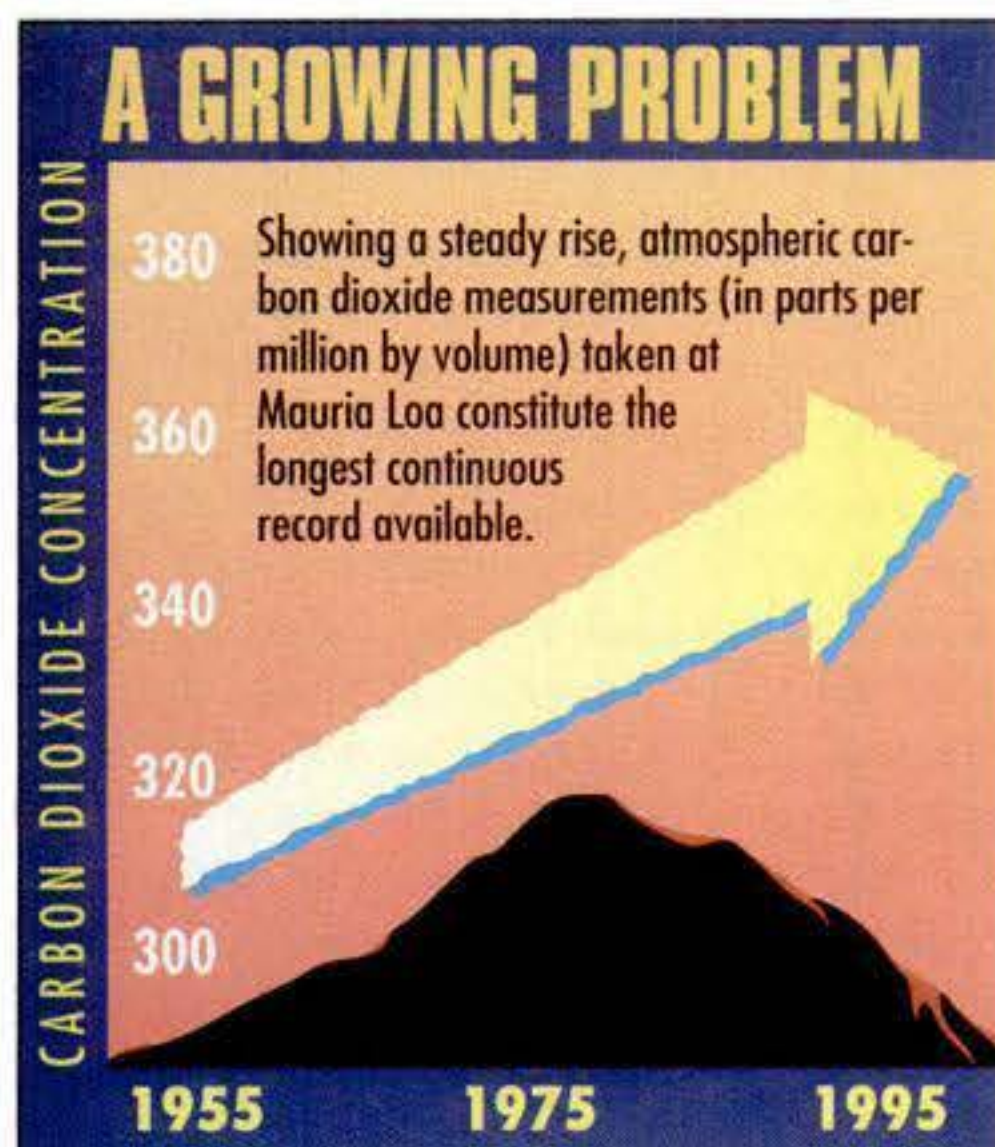
The proposed power plant would be a tanker-size ship, anchored about 150 miles offshore over a pre-drilled production well. The Norwegians envision a generating capacity of about 1,000 megawatts, using alternators driven by gas turbines, plus steam turbines fired by heat from the exhaust gas. Special processing equipment would extract the carbon dioxide from the exhaust of the fossil-fueled turbines, which is first cooled to shrink

the gas volume, using heat exchangers comparable to the intercooler of a turbocharged piston engine.

Next, the carbon dioxide could be compressed for injection. While the compressors consume power, the Norwegian researchers calculate that the total cost of gas processing would be covered by the economic rewards of carbon dioxide injection, quite aside from the environmental benefits.

On the electrical side, the alternating current generated would be rectified to become direct current to reduce losses along the submarine cable. Then it would be reverted to alternating current on land for connection to the local grid. Such sea-based generators could enable Norway to export clean electricity to countries with more polluting sources of energy, such as Denmark, which is heavily dependent on coal-fired plants.—David Scott





problem is so urgent and widespread.

Researchers in both Japan and the United States even suggest that releasing genetically altered organisms into lakes, marshes, or the sea could be a way to counter rising atmospheric carbon dioxide levels. "Scientifically, I think it is possible," Miyachi says. "But it is unclear whether people would accept the idea of releasing bio-engineered organisms into the natural environment. Before anything is released into nature, it would have to be thoroughly researched. And that will take time."

Long-term projects are a specialty of Japan's Ministry of International Trade and Industry. In 1990, MITI established a separate research arm, the Research Institute of Innovative Technology for the Earth (RITE), specifically to pursue technological solutions to environmental problems.

RITE's most idealistic—some say unrealistic—project is to harness photosynthesis in order to biologically fix carbon dioxide in plant tissue, and then to process that tissue into such products as fuel oil and animal feed. In RITE's plan, carbon dioxide from power plants would be bubbled through large tanks filled with organisms like the algae discovered at the Kamaishi lab. Sunlight for photosynthesis would be gathered and concentrated by solar collectors, and the plants would be periodically harvested after taking up carbon dioxide. Solar energy would even be used to run the process.

"The goal is to not use additional [fossil-fuel] energy," says Isao Karube, architect of the scheme and professor of bioelectronics at the University of Tokyo.

Realizing this vision will demand advances in several fields, but the key is finding organisms capable of digesting large amounts of carbon dioxide quickly. Karube says his own laboratory and the labs of the Marine Biotech-

nology Institute have together screened some 7,000 microorganisms, many never before classified. "We're working as hard as we can just to come up with names," says Marine Biotechnology's Miyachi.

The problem with the biological approach is that microorganisms take up relatively small amounts of carbon dioxide in photosynthesis. Miyachi says that under natural conditions *Chlorococcum littorale* would need a 100-square-mile pond to handle the carbon dioxide emitted by a 500-megawatt coal-fired power plant. "That's absurdly huge," he says.

There are two approaches to solving this problem. Miyachi says that in a natural pond, sunlight strong enough to cultivate algae only penetrates about two inches beneath the surface. Fiber-optic strands could carry the light farther into the water. Prototype devices have been developed, but they are likely to be very expensive to scale up. American systems that also involve algae are under development [see "Down On The Farm"].

The second approach is to genetically increase the ability of the organisms to absorb carbon dioxide. Karube describes this as "the ultimate goal of this project." But even with advances in the fixation rate and cultivating conditions, Karube sees a limited role for an algae-based system because of the expense of scaling up the bioreactors and sunlight collectors. He thinks it will only prove suitable for handling exhaust streams

with relatively low levels of carbon dioxide, such as from chemical processes and liquified-natural-gas-burning power plants, which emit gases with carbon dioxide concentrations of only about three percent. For coal-fired plants, other processes are likely to prove more viable.

Several Japanese research projects are studying methods for removing carbon dioxide from flue gases. At Tokyo Electric Power Co.'s power station in Yokosuka, researchers are operating two pilot plants that remove carbon dioxide from stack gases. One plant uses a physical process called *adsorption*, while the other features a chemical process called *absorption* [see illustrations].

In the first process, flue gas is filtered through pellets of the mineral zeolite, and carbon dioxide molecules adhere to the pellets. The second process relies on a liquid chemical that absorbs carbon dioxide from flue gas.

Both processes are nearing the end of a two-year trial evaluation. "Based on our experience, there are no problems with the physical adsorption process," says Motoshi Uchiyama, a Tokyo Electric Power engineer. The chemical absorption process has proven troublesome, however, with significant degradation of the chemical absorbent and corrosion of the equipment, but it is still technically feasible.

Neither technology is about to be implemented, however. The pilot plants in Yokosuka are each only one-thousandth of the size that would be required to handle all of the power

DOWN ON THE FARM

Scientists in the United States are cultivating plants that could extract carbon dioxide directly from the atmosphere, rather than from concentrated stack gases. Reforestation is one possibility. Tree plantations might help counter rising carbon dioxide levels, but this would require huge expanses of land. Again, researchers are looking to the ocean for answers.

In a project sponsored by the Electric Power Research Institute (EPRI) and conducted by Neushul Mariculture of Goleta, Calif., researchers investigated the feasibility of developing huge, floating "farms" made of California kelp. On top of

the kelp, technicians would attach crops of calcareous algae, which take up carbon dioxide and convert it to calcium carbonate. These algae would grow heavier as they consumed carbon dioxide, and eventually the entire farm would sink to the ocean floor, only to be replaced by a new farm.

In another scenario, technicians would launch floating farms in an area of the ocean with plentiful nutrients. As ocean currents carried the farms into low-nutrient areas, the farms would die and sink.

The cost for developing such unmanned farms is expected to be relatively low, but researchers have expe-

rienced problems attaching the calcareous algae to the kelp. And, according to early calculations, the farms would have to cover about one million square miles of ocean surface in order to handle current carbon dioxide emissions.

Researchers sponsored by EPRI and the Salt River Project are also looking at the possibility of sequestering carbon dioxide in halophytes, plants that grow in saline soils. At a study site in Mexico on the Gulf of California, researchers haul and bury crops of halophytes, or plow them back into the desert soil to prevent them from rapidly decomposing.—Dawn Stover

station's exhaust. Scaled up, the carbon dioxide removal equipment would be as big and expensive as the boilers themselves.

"Our economic analysis is not yet complete," Uchiyama says. "But it appears electricity rates would have to double or triple to cover the costs of implementing these techniques."

Studies by the utility-supported Electric Power Research Institute in the United States have produced similar results: Capturing and compressing carbon dioxide for disposal would require up to 35 percent of the electricity generated by a power plant.

Cost is not the only problem. "We have to decide what to do with the carbon dioxide," says Hiroshi Shikata, deputy director for environmental research at Japan's Central Research Institute of Electric Power Industry.

One option is to store it in the form of carbon black [see "Stockpiling Carbon"]. Another option is to pump the carbon dioxide into working or abandoned oil and gas wells. This is already being done at an oil field in Oklahoma. Shikata says the technique is only feasible for power plants located near oil and gas fields.

To dispose of carbon dioxide from other power plants, some researchers are eyeing the sea. A group of Norwegian scientists hopes to build a floating power station that would extract oil or gas from an undersea reservoir and pump carbon dioxide back into the reservoir [see "Burial at Sea"]. In a more typical scenario, carbon dioxide would be liquefied at an inland power plant and transported to sea for disposal. Several labs are working on methods for liquefying carbon dioxide.

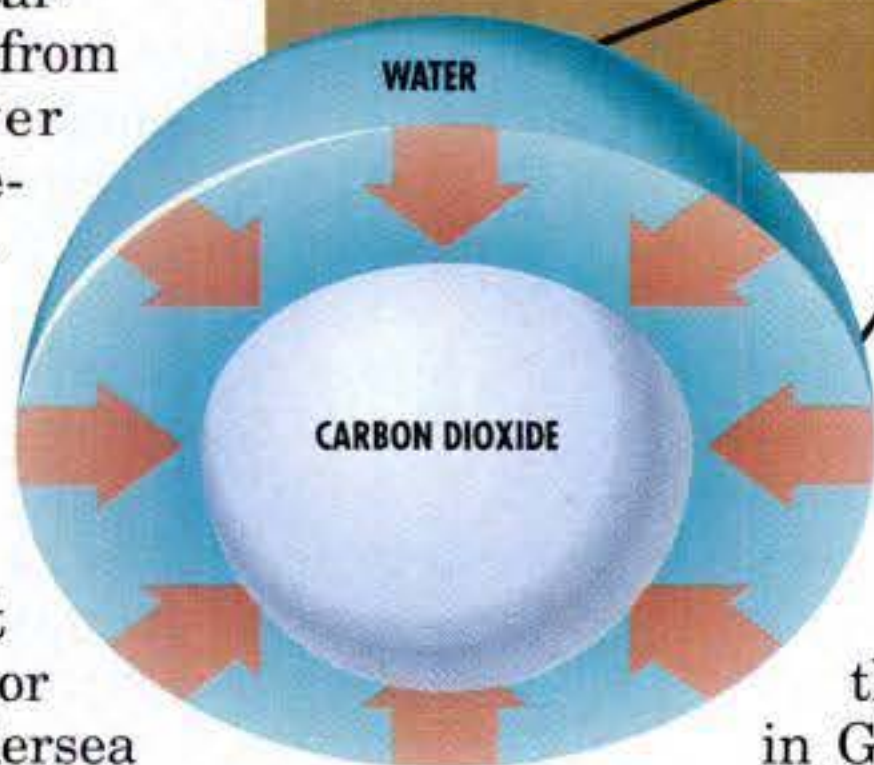
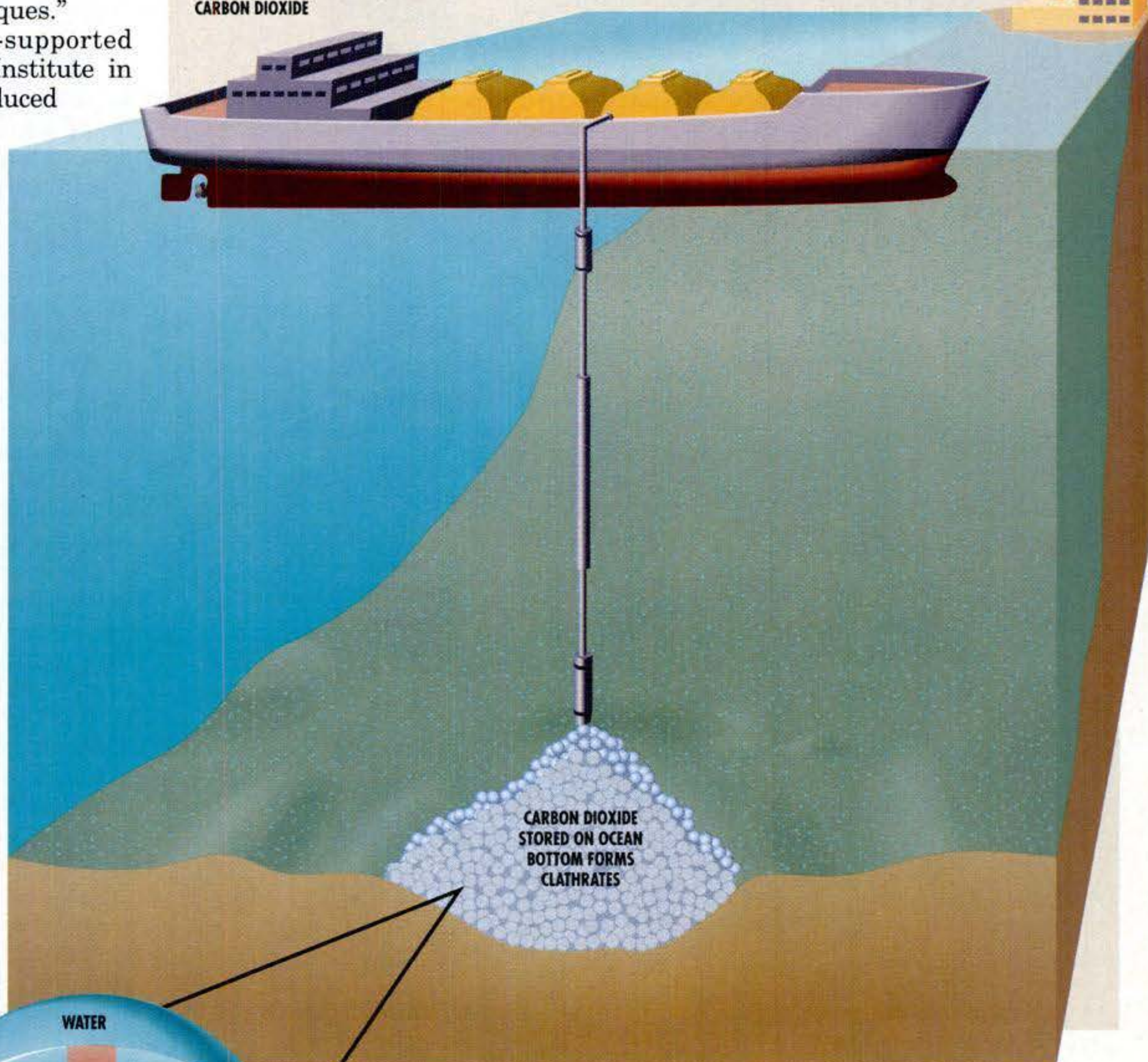
In 1989, a Japanese deep-sea research vessel named *Shinkai 2000* found liquid carbon dioxide in an apparently stable state occurring naturally on the ocean floor. "At 9,800 feet, liquid carbon dioxide is heavier than seawater," Shikata says. "It is thought that carbon dioxide could be safely

A GARBAGE BARGE FOR CARBON DIOXIDE

Researchers are exploring the idea of shipping liquefied carbon dioxide to sea, then pumping it to the ocean floor. Heavier than seawater, the carbon dioxide is likely to stay where it's put. High pressure causes the formation of clathrates, solid compounds in which carbon dioxide molecules are surrounded by water molecules.

TANKER TRANSPORTING LIQUEFIED CARBON DIOXIDE

POWER PLANT



stored at that depth."

The institute envisions transporting liquefied carbon dioxide to sea in tankers and then pumping it down to the ocean floor. A scientist at the University of Stuttgart in Germany has even proposed the creation of dry ice "torpedoes," made from frozen carbon dioxide, that would be fired into deep ocean areas. Researchers in Japan, the United States, and Europe are studying the technical feasibility, environmental impact, and costs of ocean disposal.

At the Tokyo Electric pilot plants, where carbon dioxide is removed from flue gases by physical and chemical processes, a small portion of the collected carbon dioxide is liquefied and injected into seawater within a container that simulates the pressure at a depth of 9,800 feet. The liquid carbon dioxide takes on the consistency of

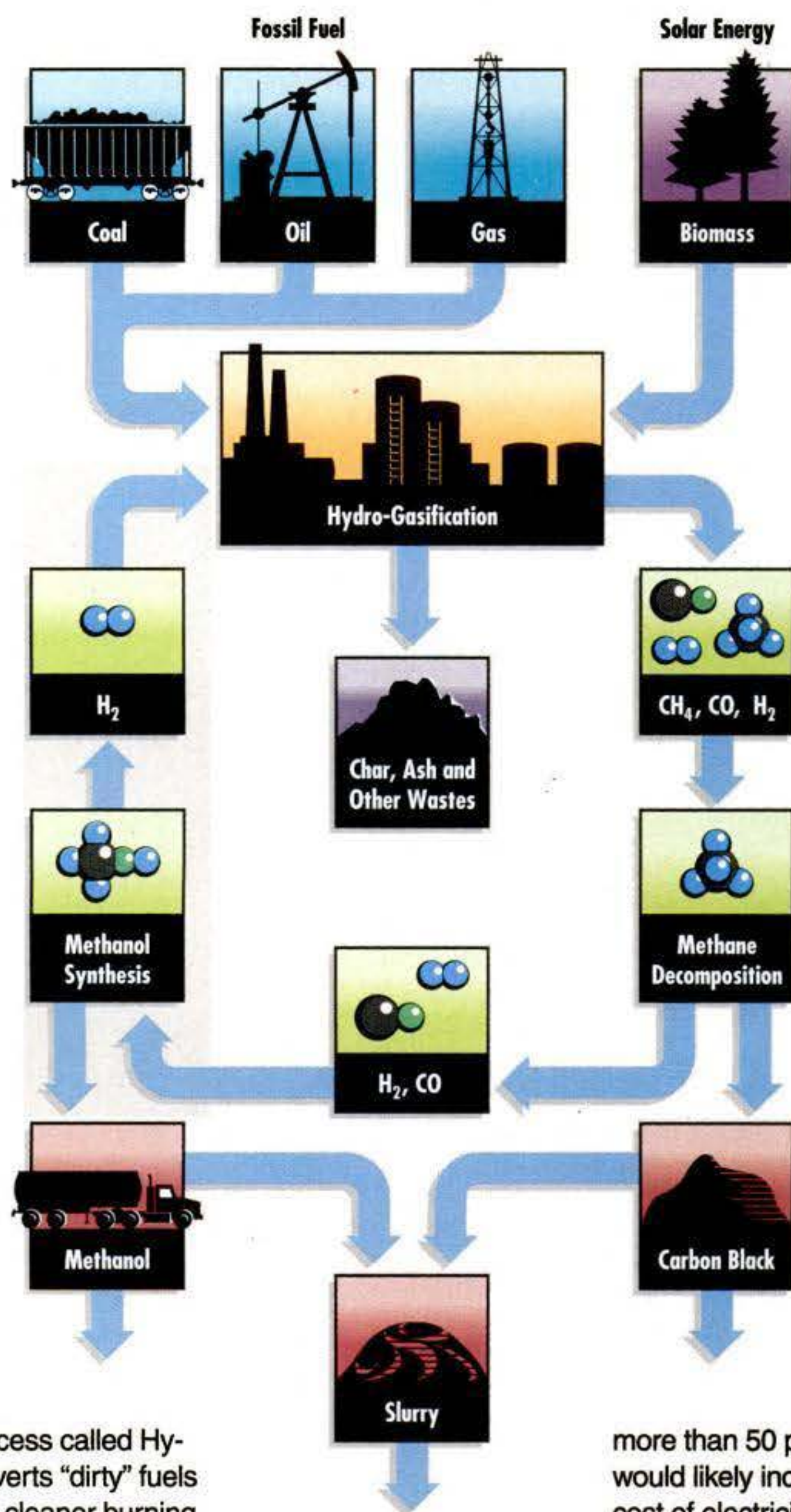
slushy snow and gradually sinks to the bottom.

Because of the high pressure, the carbon dioxide and seawater form clathrates, solid compounds in which carbon dioxide molecules are contained within lattices formed from water molecules. Still, scientists have only a rudimentary understanding of how clathrates behave in the ocean. Shikata says environmental safety will have to be verified before any dumping occurs.

One way of avoiding disposal would be to recycle carbon dioxide, combining it with hydrogen to form hydrocarbon fuels such as methane or methanol. Researchers are trying to boost the performance of catalysts that foster such reactions.

Sendai-based Tohoku Electric Power recently announced advances using a rhodium-manganese catalyst. Carbon dioxide and hydrogen were mixed at a ratio of 1:4, heated and pressur-

STOCKPILING CARBON



A hybrid process called Hydrocarb converts "dirty" fuels like coal into cleaner burning methanol, while it turns carbon dioxide into a powder that can be easily stored.

Invented in the mid-1980s at Brookhaven National Laboratory by Meyer Steinberg and Edward W. Grohse, Hydrocarb juggles three complex processes. In the first, a carbonaceous fuel—such as coal, oil, or even solid waste—is gasified with hydrogen at high temperature and pressure, producing methane, hydrogen, and water.

In the second step, the methane decomposes at high temperature in a methane pyrolysis reactor to form hydrogen and carbon black, as well as a smaller amount of carbon monoxide. The carbon black, a fine

powder of pure carbon, is removed and made into pellets. It can be sold as a fuel.

In the final step, the hydrogen and carbon monoxide are cooled and converted to methanol in a methanol synthesis reactor. Unreacted hydrogen and methane are recirculated to the gasifier.

Because Hydrocarb splits a dirty fuel into two cleaner fuels, it might offer a new way to reduce carbon dioxide emissions. For example, carbon black and methanol could be used in efficient combined-cycle plants.

Another option would be to use only the methanol, while storing the carbon black in abandoned mines, reducing carbon dioxide emissions by

more than 50 percent. This would likely increase the cost of electricity, but if global warming proves negligible, the carbon could be removed and used as a fuel.

Within the next two years, a prototype burner will sputter to life in Los Angeles County. The South Coast Air Quality Management District plans to convert biomass rather than coal. Built by Acurex Environmental of Mountain View, Calif., the pilot plant will use 50 pounds of biomass (in this case, wood waste and sewage sludge) an hour. "Processing coal, oil, and gas with wood, then storing the carbon black and using the methanol as a fuel, results in a meaningful reduction in atmospheric carbon dioxide," Steinberg says.—Peter Britton

ized, then passed through the catalyst. Tohoku scientists claim that virtually all of the carbon combined with hydrogen molecules to form methane. The company believes this technology can be scaled up. But vice president Yoshinobu Katsumata says, "We are still at the experimental stage." Hydrogen and rhodium are both expensive commodities. And the carbon dioxide separation and conversion processes also require energy, which would result in an overall decrease in power-plant efficiency.

A group at a Toshiba laboratory in Yokohama is trying to skip the carbon dioxide separation step. Exhaust gas and a hydrogen-based gas such as acetylene are confined in a chamber and then bombarded with either an electron beam or a laser beam. Excited by the beam energy, the gas molecules break apart and reform in different combinations. So far, the process has yielded methanol and carbon monoxide, which could be used as a feed stock for making more methanol.

The scientists have also found that solid organic polymers such as polystyrene precipitate out of the gases. Varying the chemical content of the supply gas could result in the generation of other products such as methane and propane.

Takataro Hamajima, manager of Toshiba's advanced engineering group, says one of the chief benefits of this approach is that it is extremely simple. Also, the basic techniques of exciting gases with lasers and electron beams are well known. But so far, yields of useful products are minute. "We think there is a possibility of a future breakthrough," Hamajima says. "But we have to approach it as a very long-term project."

None of the scientists working in this field foresee a quick fix. A MITI advisory panel recently concluded that carbon fixation schemes will not have a significant effect on carbon dioxide emissions until well into the next century. At the same time, the group said, conservation can only go so far.

"It is not possible to stem global warming by energy conservation alone," says Yoriko Kawaguchi, former MITI vice minister for global environmental affairs, who oversaw the development of many of MITI's current environmental programs. "We need technological breakthroughs," she says. MITI recognizes that those breakthroughs are not going to be easy to achieve. "We have to start research and development as soon as possible," Kawaguchi says. "The fruits will come later."

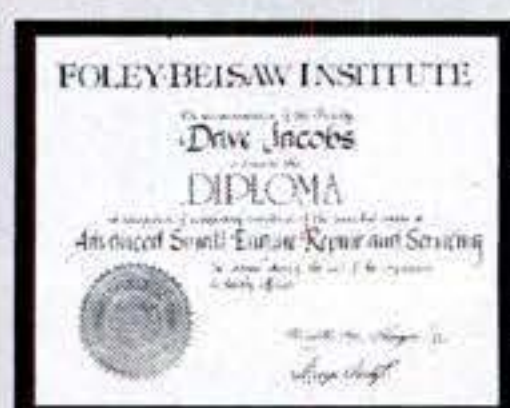
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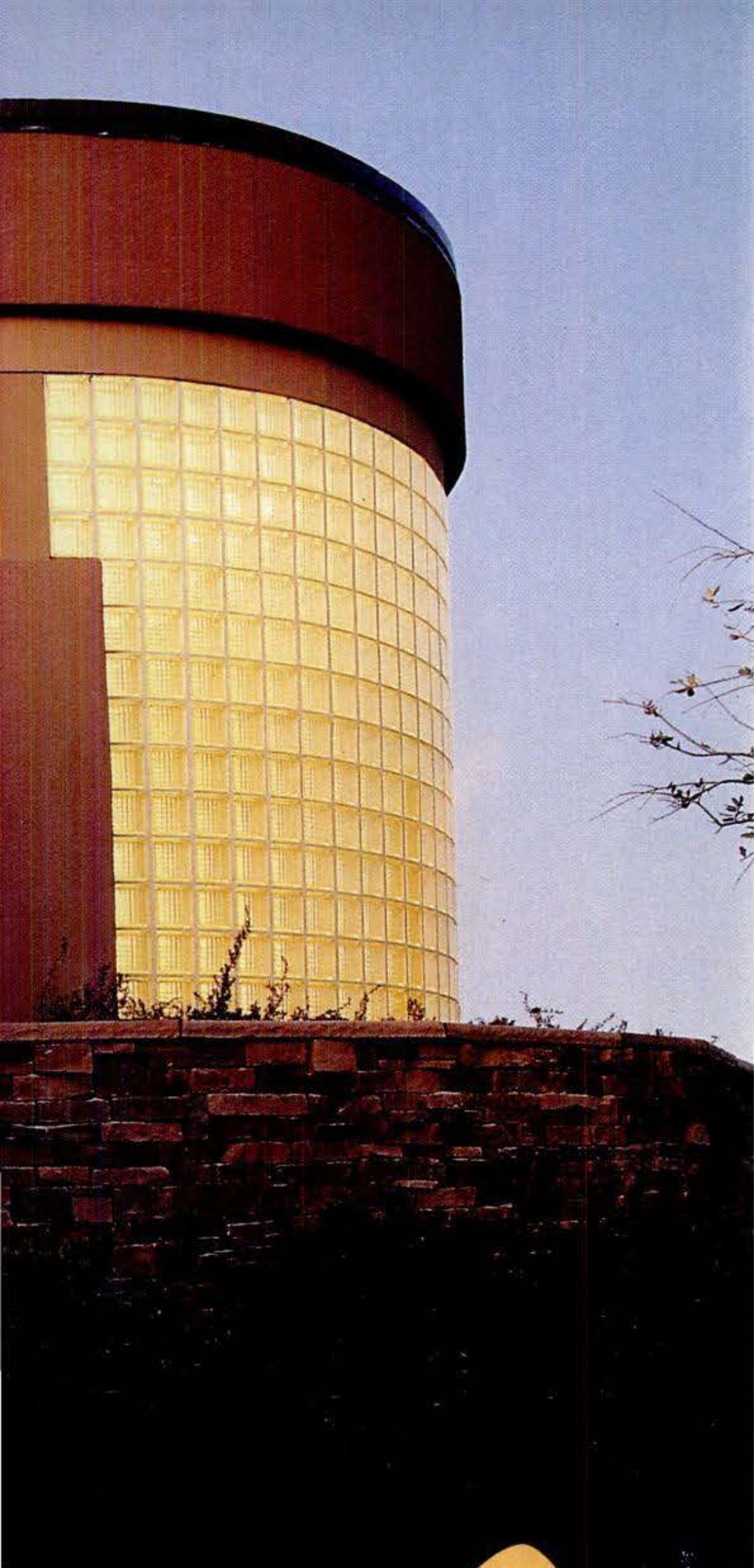
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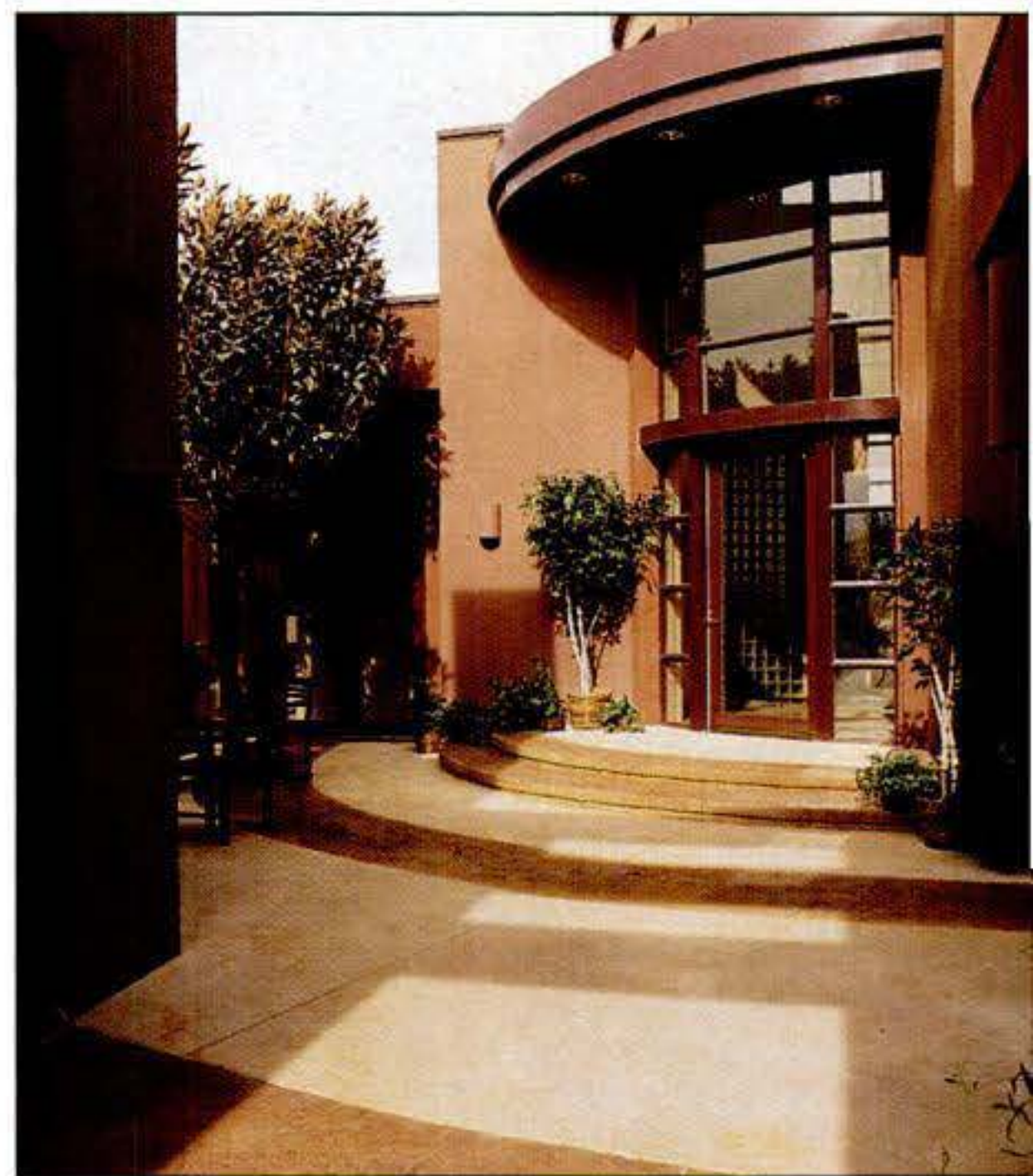
The
NEW AMER

An amazing adaptable showcase proves how far



BY MICHAEL MORRIS

T



he Nevada sunset glows like crimson fire as you pull into the driveway of this home on the edge of the desert. A hidden sensor recognizes your vehicle, and the motor court's gates open silently, then swing shut as you pass. Outdoor wall sconces, shining softly in the fading light, automatically increase in power to illuminate your path. Unnoticed, a tiny camera scans your presence, as an interior chime announces your approach; anyone at home can view the scene on any television and unlock the home's entry by simply touching a button on the nearest phone.

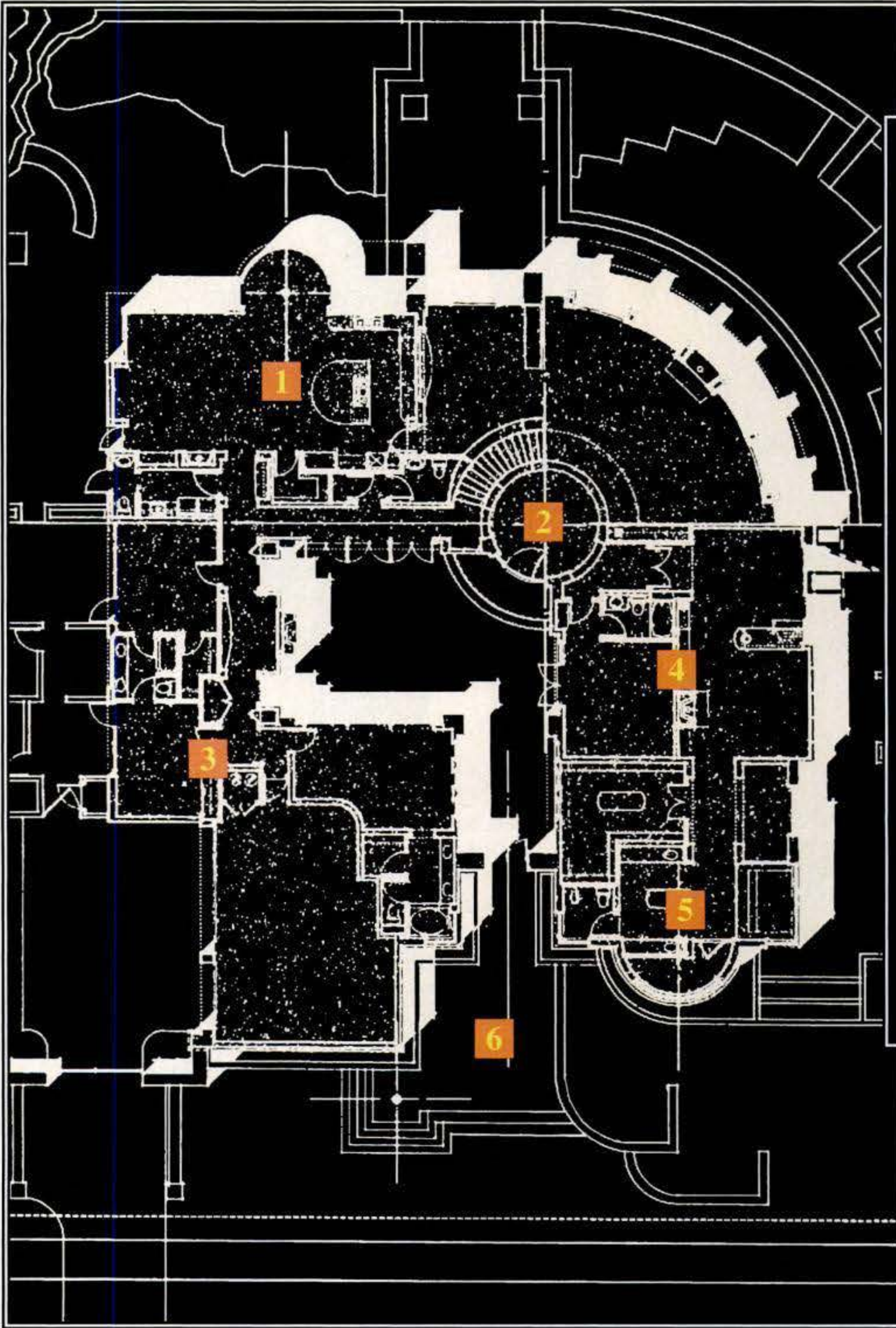
PHOTOS BY JOHN B. CARNETT

As you enter and amble through the house toward the master bedroom, wall sensors track your passage and adjust the lighting, along with the heating or air-conditioning and even the music playing softly in the background. In a private patio just beyond your bedroom door, water begins to splash and swirl in a rock-lined spa, as hidden heating ele-

AMERICAN HOME

House can go with innovative off-the-shelf technology.

LAYING OUT THE NEW AMERICAN HOME



1 Spacious yet cozy, the family room opens to the dining nook and the kitchen on one side, with the entry to the home theater on the other. Its glass wall faces the pool outside.

2 A circular marble-floored formal entry welcomes visitors into the curved-walled living room. The entry's tiered ceiling, 20 feet high, tops clerestory windows all around.

3 Secondary bedrooms and guest quarters occupy this wing. One bedroom was converted to the home theater. A computer center faces the central open-air courtyard.

4 The master bedroom suite takes up nearly one-quarter of the house's floor plan. A quiet reading retreat leads to the bedroom, then to a room-size closet and exercise area with spa.

5 In the master bath, fixtures are divided into separate areas: whirlpool, toilet and bidet, and a double sink counter. A circular open shower tucks into the front wall alcove.

6 In this modern interpretation of traditional Southwest style, a gate in the wall leads to an open central courtyard and the formal entry. Glass blocks in front ensure privacy within.

mony with the desertscape surroundings, there is very little that is "natural" or conventional in the way the home was constructed.

With so many different and complex electronic systems for security, lighting, audio-video distribution, and heating and air-conditioning being installed in homes to-

day, home owners find they need a master controller that can coordinate it all. Here, the answer is Total Home from Honeywell. Unlike many such systems, Total Home requires no special wiring; it operates on high or low voltage, and may be retrofitted into existing homes. House-wide security is part of its package. The system also interfaces with the company's LiteCom lighting controls, with X-10 Powerline modules (which use a home's own electrical wiring to carry control signals), and with Honeywell's programmable W180 Zone Control System for heating and cooling.

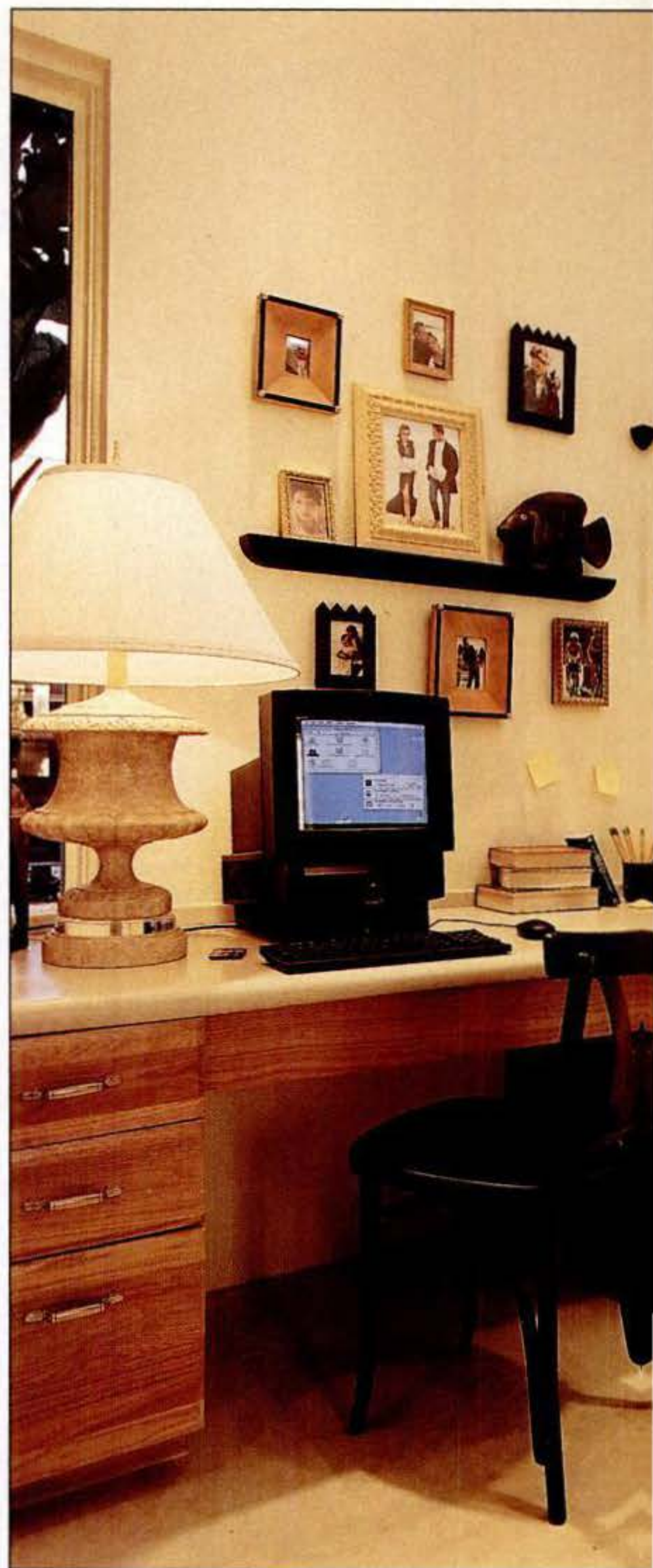
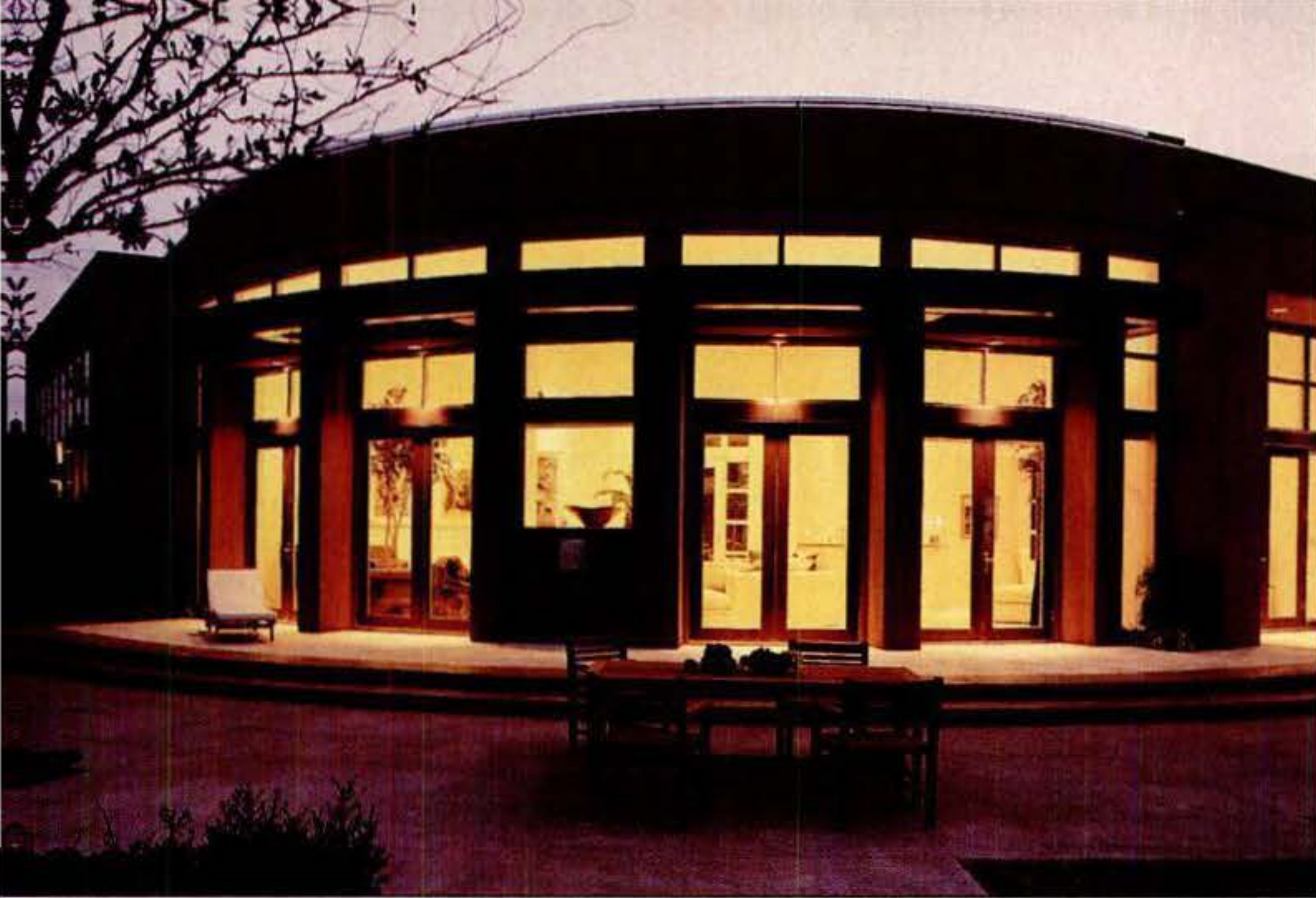
A conundrum faced by makers of home-control systems is the "VCR syndrome," which dictates that the more complex and capable an electronic system is, the more the average consumer will shrink from using it. So Total Home integrates all its features with software that responds to plain-English commands. Punch up Going Out on the menu display, for instance, and you activate security and any other preset functions like lights, appliance timers, and thermostat setbacks. "Where it differs from a lot of high-end systems is that it's pretty straightforward—it's not rocket science," says spokesman Jerry Blackman.

ments raise the water's temperature to the exact degree you prefer at that hour of the day. Before you can kick off your shoes, your favorite CD pops into the player, and the evening news appears on the TV screen beside it.

Welcome home.

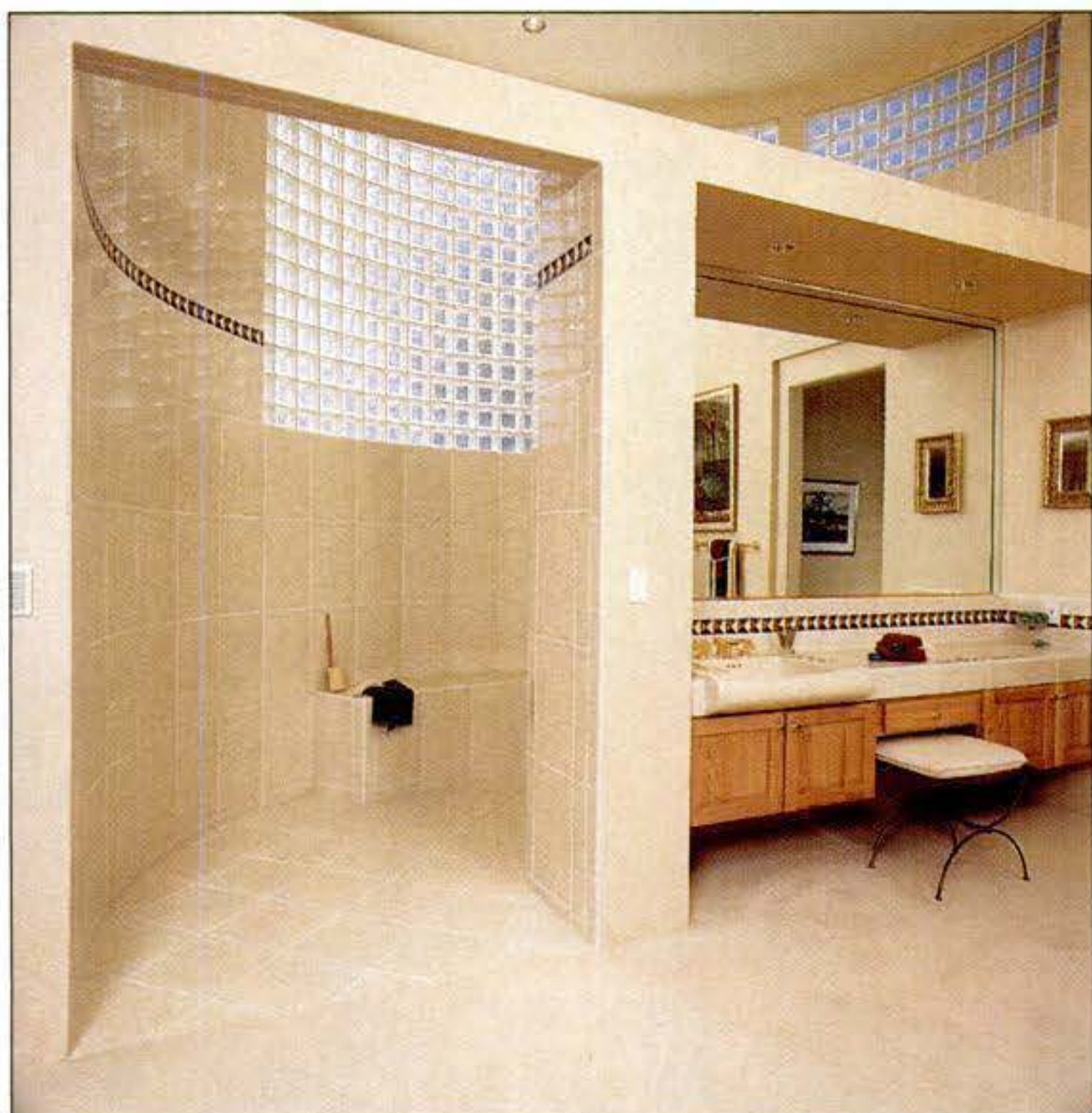
That is, welcome to The New American Home for 1994. A state-of-the-art demonstration of what is possible today in home technology, the home opened in Las Vegas in January, to coincide with the 50th annual exposition of the National Association of Home Builders. This year's New American Home is the 11th in a series of live-in houses designed to introduce new products and innovations available for today's home construction. Sponsors include POPULAR SCIENCE and the National Council of the Housing Industry, the manufacturers' arm of the home builders association.

If there is an air of unreality within this dramatically spacious showcase, it may be due to the way the house seems to anticipate one's needs, using what its creators call "adaptive intelligence" to perform many functions—without attention, or interference, from its human inhabitants. And although the stone and stucco facade appears to be in har-



Like a mirage, The New American Home mirrors its ancient desert surroundings, but the materials and products used throughout are attuned to the 21st century. Clockwise from the top, the sweeping curve of the living room wall reflects onto paving "stones" of embossed colored concrete. I want my Mac TV: This versatile home computer creates a one-stop information and entertainment area. A wall of glass separates the dining and family rooms from the pool patio. The velvet-lined home theater is a couch potato's heaven.





That means that living with the multiple-overlapping electronic control systems in this New American Home isn't confusing—it's fun. Say you want to turn on the pool lights from your armchair, but the nearest wall switch controls the lamp; you simply use a portable keypad to reprogram the switch. If you want the nighttime motion sensors to work just as hard during the day, you can reprogram them too—and make them turn lights or music or anything else on or off when you pass. But you don't even need to work that hard in this house: The heating and cooling system will "learn" your living habits, then figure out for itself how to reduce your energy bills. And Total Home's a la carte availability allows home owners to upgrade or add accessories as they choose. A basic system with 20 control points for lighting, security, and appliances starts at around \$4,000; customized setups are available at higher and lower costs.

But even a simple system offers a remarkable degree of sophistication. For example, each unit is programmed to the local time zone and latitude so that certain functions, such as activating nighttime security and dimming lights, are calibrated to the sun's angle and determined by the true time of day rather than by ambient light levels. This eliminates costly photocell equipment, makes the system more accurate and dependable, and enables it to continuously

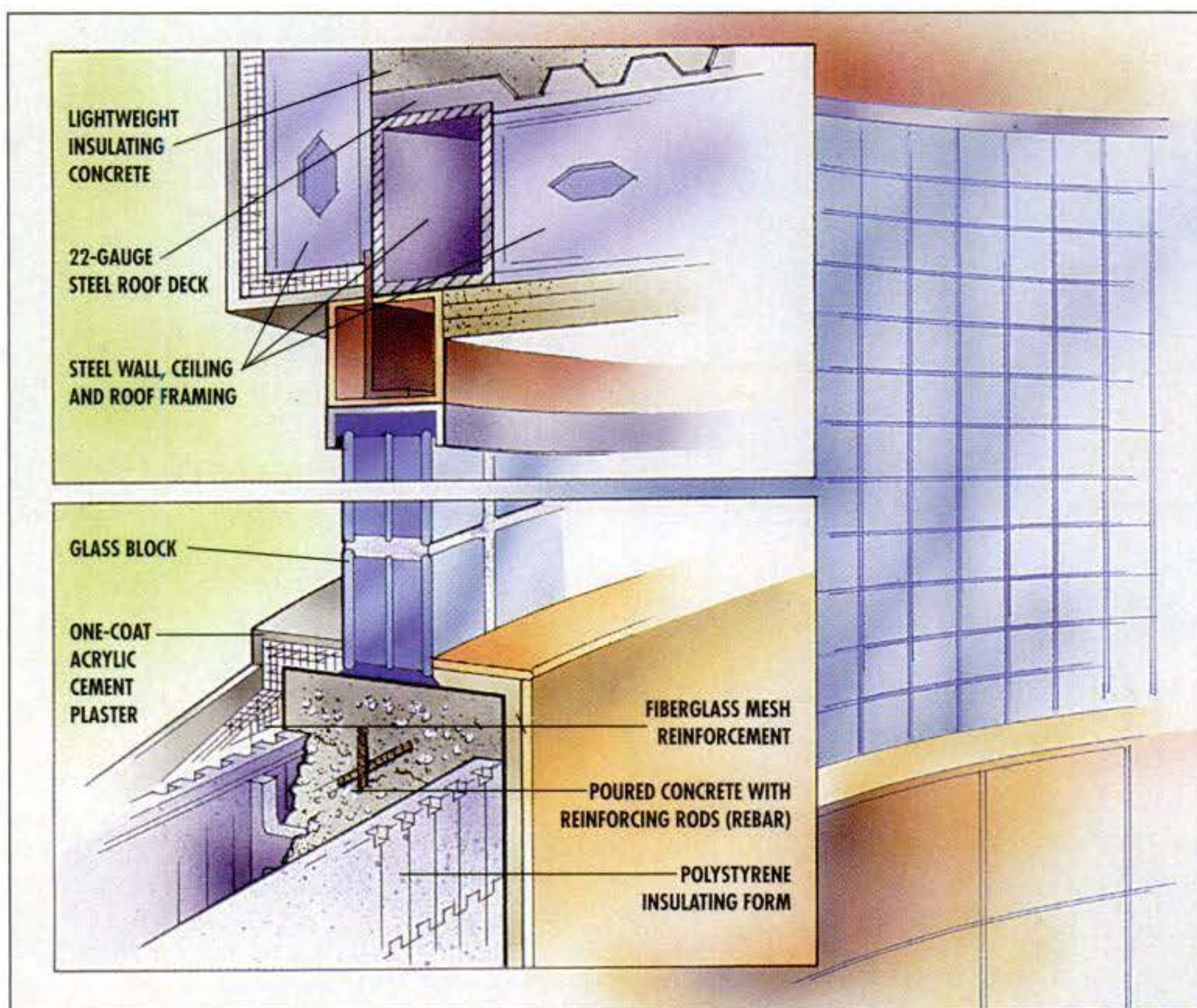
adjust its entire household operation to gradual changes during daylight hours, including shifts for Daylight Savings Time.

Adding the microprocessor-based zone controller brings the New American Home's systems integration to an even higher plane. This unit, which costs about \$1,000, can be programmed in imaginative ways: For example, it will operate within a planned budget based on kilowatts or energy costs. When home electrical use threatens to exceed the budget, the microprocessor determines how and when to shed some of the electrical load, starting with low-priority items.

Using fuzzy logic, which is based on assigned values for virtually every situation and variable that this built-in home computer operates or may encounter, it simultaneously considers many factors. These include: variances between temperature demand and operating temperatures, variances between indoor and outdoor air temperatures, temperatures in adjacent interior zones, room occupancy and lighting levels, and the amount of time until the next preset program change.

Then the controller "decides" how to balance the house's heating and cooling zones. Installer Ken Goodrich, president of Racee Co. in Las Vegas, explains that the controller "will actually adapt to surrounding conditions, outside as well as inside; make intelligent decisions; and 'recover' temperatures, whether up or down, from one heating or cooling period to another."

With 5,200 square feet of living space encircling a large open-air courtyard, the house also requires an innovative heating and cooling distribution plan. Four separate furnaces and air-conditioning systems are split into 10 zones. Each system includes an electronic air cleaner and an energy-recovery ventilator, which exhausts stale air and draws in fresh outside air. Using harmless carbon dioxide as a trace element for all other gases, special monitors shift the ventilators into high gear when they detect that



When you peel away the surface of the luxurious master bath (top), you can see the innovative building practices employed in the construction of The New American Home (above). The exterior walls were formed from foam blocks stacked atop one another and filled with poured concrete; in this ConForm system, the foam sandwich allows the concrete to cure to 50 percent greater compressive strength. In the interior walls and ceiling, standard wood "stick-built" construction is replaced with lightweight steel framing.

ILLUSTRATION BY JANA BRENNING

indoor air pollution is elevating to uncomfortable levels.

While the network of electronic controls may be subtly hidden, a visitor can't help but notice the profusion of audio, video, and computer electronics equipment scattered about the house. A centerpiece of The New American Home for 1994 is its home theater. No bigger than a bedroom, this velvet-lined, comfortably upholstered Bijou can show high-quality laser-disc movies. The entire room comes to life at the touch of a button: Automatically, curtains on the far wall rise to reveal the screen, as motorized drapes close to block light from the window and doorway. The room lights dim, the air conditioning shifts to occupancy mode, and the Lucasfilm THX Home Theater System starts the show. This setup combines a Mitsubishi overhead projector with a 100-inch (diagonal) fixed screen, Kenwood amplifiers and surround-sound processors, and a four-channel sound system using matched four-way Altec Lansing front and center speakers, rear dipole speakers, and twin subwoofers. To enhance viewing on the large screen, the projector is equipped with an Eilex scan converter, which sharpens pictures to twice their normal resolution.

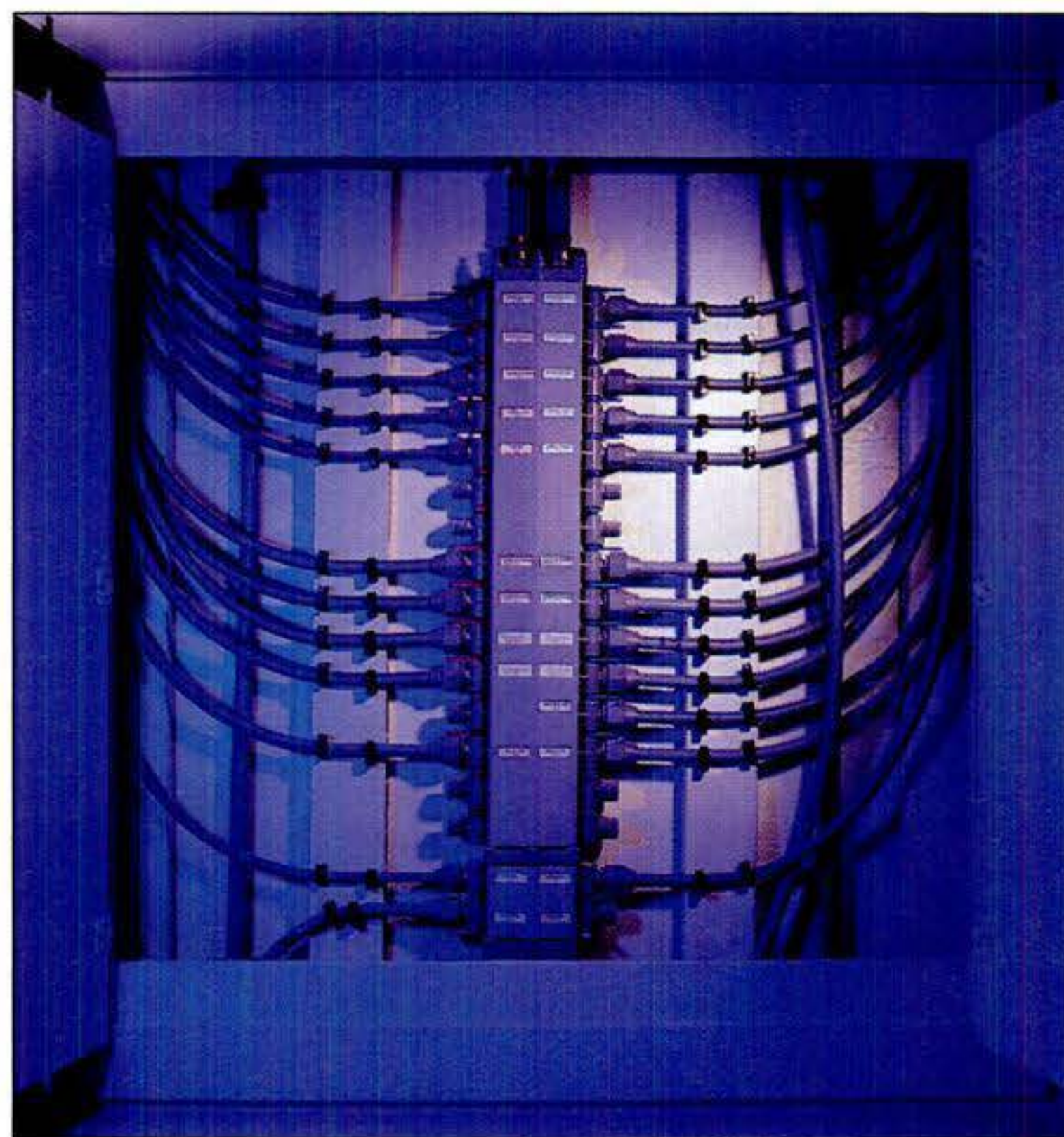
For everyday TV watching or stereo listening, the family room just off the home theater sports its own built-in rear-projection Mitsubishi television with a 50-inch screen, along with an array of ceiling-mounted and in-the-wall JBL speakers; Harman Kardon amplifiers; a surround-sound processor; and CD, VCR, and laser-disc players. From any other room of the house, you can operate and watch what is on this TV or listen to its music system via Channel-Plus and Audio Ease distribution equipment.

Not to be outdone, the master bedroom features a fully equipped audio-video center as well. In this spacious high-ceilinged retreat, a Heatilator gas fireplace competes for attention with a ProScan 35-inch Cinema-Screen TV. Unlike standard screens, which are almost as tall as they are wide and therefore lop off the edges of Cinemascope movies, this 16:9-ratio letterbox format displays wide-screen films in their entirety.

Yet another multimedia area occupies a niche in the passageway leading to the children's and guest bedrooms. This space is reserved for school homework, video games, TV watching, and CD-library viewing—all made possible through Apple's new computer, the hybrid Macintosh TV. This all-in-one-box unit has a coaxial connection for cable or broadcast TV, along with ports for standard 3.5-inch computer disks and CD-ROM multimedia disks. Switching between sources is easy to do on this machine, which can even capture freeze-frame television images for use in computer and print displays.

The plethora of entertainment equipment is highly visible, but the subtle beauty of the natural-looking "stone" and other materials used in the construction of the house disguises their true nature. For example, the multicolored sandstone wall veneers and landscape parapets are really faux stone made of less-costly concrete. The adobe-like exterior walls were formed using lightweight, polystyrene foam blocks stacked one atop another that were then filled with poured concrete. Made by American ConForm Industries of Santa Ana,

[\[Continued on page 83\]](#)



All plumbing supply lines are conveniently labeled, organized, and accessible in two manifolds, located at each end of the home's sprawling circular layout (above). Flexible plastic tubing used for the water lines is less expensive and easier to install than copper pipe. Using a Honeywell wireless programming unit, low-voltage LiteCom switches can quickly be changed to perform new functions (below). Up to four switches can occupy each standard-size switch box. All rooms in the house, and outdoor areas, also have a motion sensor and audio-distribution control pads.



Heavy haulers

[Continued from page 64]

coil springs and a solid axle up front—even with four-wheel drive—while the Chevrolet uses torsion bars and a fully independent front axle to achieve the same goal.

The Dodge's suspension tuning is dramatically improved over previous designs. The variable-ratio steering box has been remounted to improve frame rigidity, the front frame rails have been boxed and stiffened, and the leaf springs have been lengthened; all this gives the big truck a crisp driving

feel. The suspension is compliant enough to provide a superior feel even on washboard roads.

The Dodge Ram's performance on our high-speed handling tests surprised us. Steering is precise and responsive, body roll minimal, and the braking feels positive. The brakes include rear-wheel-only antilock, which has become standard on all full-size pickups in the United States. This prevents spinouts when braking on icy patches, but does nothing to prevent

front-wheel lockup and the subsequent loss of steering control. Dodge offers a full four-wheel antilock option, even on four-wheel-drive models.

A longer wheelbase puts the Dodge in second place in terms of handling, as the Chevrolet C2500 emerged as the king of the pylons. Even though its measurable cornering power proved to be less than that of the Dodge, the Chevrolet led in the slalom and the lane-change tests, a testimony to its quick, precise steering and overall balance. Lane change and slalom proved to be weak points for the Ford F-250 because its double-axle front suspension promotes excessive roll and vague steering. Ford has stuck with its front suspension despite these steering problems, citing the durability of the forged axles. The next-generation Ford pickup, due in 1995, is unlikely to carry over the design, however.

In the final judgment, it is character, more than simple performance statistics, that distinguishes the trucks from each other. The smooth-running diesel engine, the precise handling and the good ride of the Chevrolet C2500 all lend themselves to day-to-day use, even in this heavy-weight category. Yet it's ironic that Chevrolet, a ground-breaker in civilizing the heavy pickup field in the late 1980s, has features that now seem a bit dated. The instrument panel is poor, and the ergonomics are awkward. Chevy needs to make its excellent performer more user-friendly.

Ford's F-Series trucks, long overdue for an update, suffer more serious problems. In particular, the front suspension needs to be reformed. The cab interior is functional and seems more accessible than the Chevrolet C2500. The diesel option effectively combines tractability and power.

Leading the truck industry by a wide margin, Ford and Chevrolet have become masters at offering combinations of power, features and load capacity to suit almost any condition (see the engine options box).

Dodge, on the other hand, has assumed a more specialized role, concentrating on higher power ratings, a longer wheelbase, and rugged specifications. These are combined with a smooth ride, precise handling, and a spacious cab. The Dodge Ram pickup is a thoroughly modern design that meets a multitude of goals with little or no compromise. The styling is eye-catching but also functional, remaining faithful to the premise of what a work truck should be. The Dodge Ram is the freshest new approach to truck design to come along in years.

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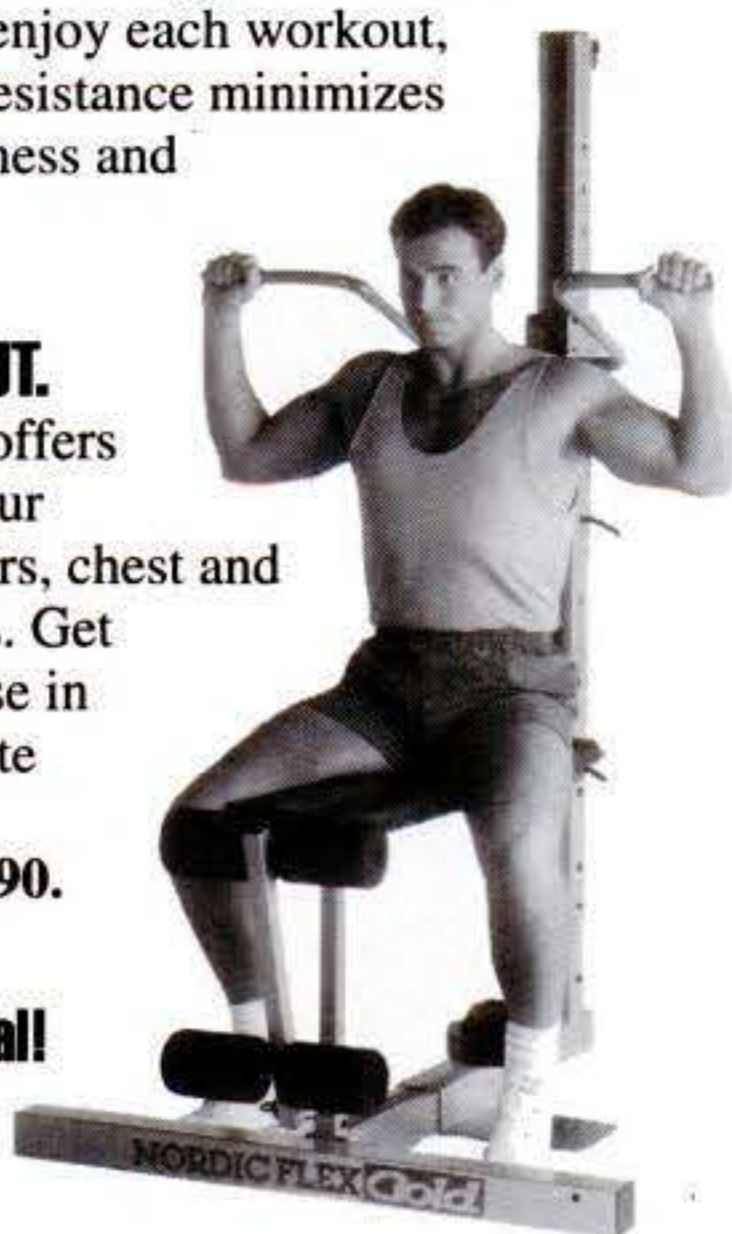
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INNOVATION REPORT

Amazing, Patented* "Black Box" Turns Your Existing Stereo Or TV Into An Extraordinary Home Theater Sound System...

Technology Breakthrough Makes Great 5-Channel Surround Sound Super Easy, Super Affordable.

EDITED BY ALEXANDER BURTON

Getting short-changed in anything—even ever so slightly—is always at least a little annoying. For example, you put your favorite artist's live-performance CD on your stereo and it just doesn't sound completely life-like, which, after all, is the quality you're looking for.

Or, you rent a video and watching it on your VCR and TV just isn't as exciting as seeing it in the theater. You feel slightly short-changed.

Well, all that's about to end now, thanks to a remarkable technology breakthrough from Dynaco, one of America's pioneering audio brands for over 40 years.

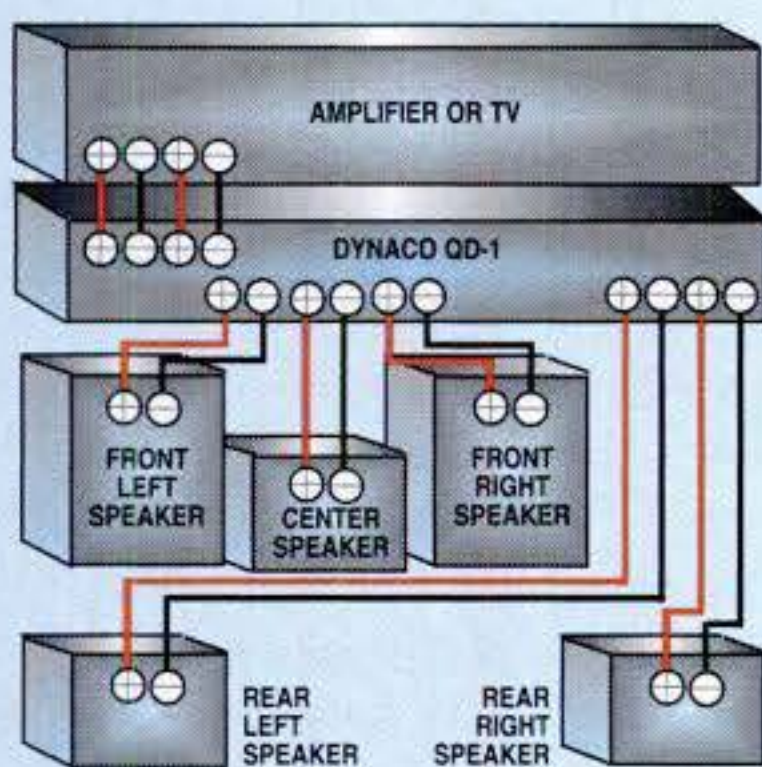
Dynaco's QD-1/Series IIL full 5-channel Surround Sound Decoder now makes it possible for you to get that same incredible sound sensation you feel sitting in a theater, a club or at a concert—right in your own home! And it does it perhaps better, than surround sound systems that cost up to 10 times as much.

The QD-1 easily connects to your existing two-channel stereo receiver or TV and converts them—almost magically—into a rich, full five-channel surround sound system.

Hook-Up Is As Easy As A-B-C.

Connecting your QD-1 couldn't be simpler!

- Instead of connecting your stereo amplifier (or TV amp) outlet to your main speakers, connect those leads to the QD-1 input terminals.
 - Connect speaker wire from the QD-1 "Front" terminals to your main speakers plus a center speaker, if you wish.
 - Connect speaker wire from the QD-1 "Rear" terminals to 2 rear speakers.
- That's it! In addition, the QD-1 comes with easy-to-follow instructions and diagrams.



The Dynaco Difference. If simplicity is a virtue, then the Dynaco QD-1/Series IIL may be downright righteous! Because unlike the much costlier systems that elaborately process—and ultimately distort—surround sound signals, the QD-1 uses exclusive *Dynaco Matrix™* passive technology to unlock them.

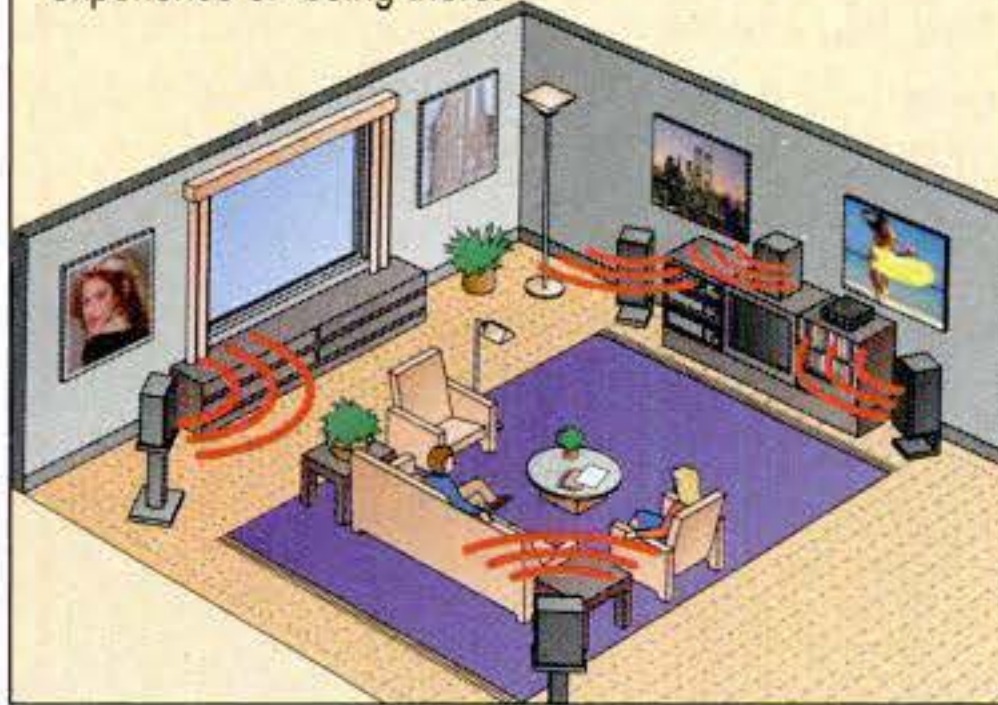
In this patented 5-channel system, Dynaco makes use of the fact that the difference in left channel stereo signals and right channel signals—called "L minus R"—is where the depth and spatial cues that generate surround sound are always found. They designed the QD-1 to "look at" an

incoming stereo signal, identify the "L minus R" information, sort out front, rear, left, right and center signals, and then route them to the proper channels. The beauty of the Dynaco technology is that it does this without any re-amplification or filtering.

The Incredible Result. You end up with the purest, most natural sound and music possible coming from exactly the right place with the absolute truest sense of space and depth you could ever imagine. In fact, once you listen to music on this full 5-channel system, you'll never want to go back to plain stereo again.

It's Like "Virtual Reality" In Sound!

Here's why true surround sound is more than just extra speakers: Special signals for each speaker are what makes surround sound so compelling. These signals are already in your CDs, videotapes and laser discs, but without a decoder, you can't hear them. You'll simply get 2-channel sound on 4 or 5 speakers. But the Dynaco QD-1 decodes and routes the special signals to the proper speakers, giving you the extraordinary sound experience of "being there."



One of the other major advantages of this Dynaco system is that to have it sound great, you don't need big, expensive rear channel speakers or a costly speaker for the center front channel.



Dynaco recommends its A-10 Satellite Speakers for the rear channels and the A-10V Shielded Center Speaker if you want to enhance dialogue.

Q&A on the Dynaco Home Theater Surround Sound System.

- Q.** How much power can it handle?
A. The QD-1 can accommodate any amplifier rated up to 200 watts per channel.
- Q.** Do I need a separate amplifier?
A. No, just use your sound system's amp.
- Q.** Can I hook it up to my TV?
A. Yes, if your TV has a stereo amp with speaker outputs.
- Q.** Can I use it if I have a sub-woofer based system?
A. Yes. The QD-1 comes with easy hook-up instructions for a sub-woofer system.



*The Dynaco QD-1/Series IIL Surround Sound Decoder is protected by U.S. Patent No. 5,265,166 (with other U.S. and foreign patents pending.) It decodes surround sound signals already in your CDs, videotapes and laser discs for unbelievable, life-like audio reproduction.

Critical Acclaim By Audio Experts.

Here's what two leading audio experts have written about the Dynaco QD-1:

"...the QD-1 produced a completely accurate and realistic surround sound experience from a variety of videotapes and laser discs with Dolby surround encoding...the QD-1 delivers home theater sound the way it was meant to be heard."

—Len Feldman, *Audio Magazine*

"High performance doesn't always have to mean high cost...Dynaco's...passive surround sound decoder turns out to be—believe it or not—a product that can turn your stereo system into a three-, four-, or five-channel surround sound (call it home theater, if you like) system...[that] yielded an amazingly realistic surround sound experience..."

—Martin Forrest, *High Performance Review*

Factory-Direct Offer. The QD-1/Series IIL is not yet available in any store at any price. As an introductory promotion, Dynaco is offering it directly from the factory at a special low price and for a limited time only.

No-Risk, In-Home Test. You know, and we know, that the only good place to evaluate any sound system is in the room for which it's intended. Because of that and because we're so certain that you'll agree the Dynaco Surround Sound System will sound as good as we've said, we'll send it to you for a 30-day, no-risk test. Hook it up, listen to it all you want and, if you're not satisfied for any reason, send it back within 30 days and we'll refund your money, no questions asked.

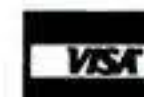
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[Continued from page 59]

three-dimensional shading effect on the pull-down menus. Another, more significant innovation was folders that would reside within folders, ad infinitum. And there was the addition of the "Apple menu," a command on the left of the menu bar that would pull down a set of tools called desk accessories that would always be available—things like a calculator, a clock, and even a little puzzle. These were all innovations that pleased the Mac team, features they desired on their own dream computers.

Not until early in 1982 did the team finally sit down to create a document that codified the Macintosh religion. Their "Human Interface Guidelines" assured that the look of the screen would be the same, no matter what application program was running. The parameters for tasks like dragging text, selecting objects, and quitting programs would be consistent and predictable. All the dialog boxes—those little windows that appear on the screen at decision points and ask you to signal your choice by moving the cursor over a button—would look alike. Every program would have sim-

ilarities on its menu bars, and similar commands. When you used a Macintosh application, you would know with virtual certainty that saving the document could be accomplished by invoking the drop-down menu under File and moving down to the fourth item, Save.

As a result, the entire software base of the Macintosh became a coherently created world, with an immediate familiarity to anyone who mastered the elemental skills of using the machine. And these skills, being visually clear and intuitively logical, would be a cinch to learn in the first place. You could launch a strange application and get something done instantly without even cracking the manual. After some painless exploration, and perhaps a glance or two at the documentation, you could probably even get serious work done.

It was an ambitious plan and, amazingly, it worked. It also set an implicit standard in computer design and elsewhere. Some years later, after praising the Macintosh Toolbox, design critic Donald Norman wrote, "Now if we can enlarge a similar spirit

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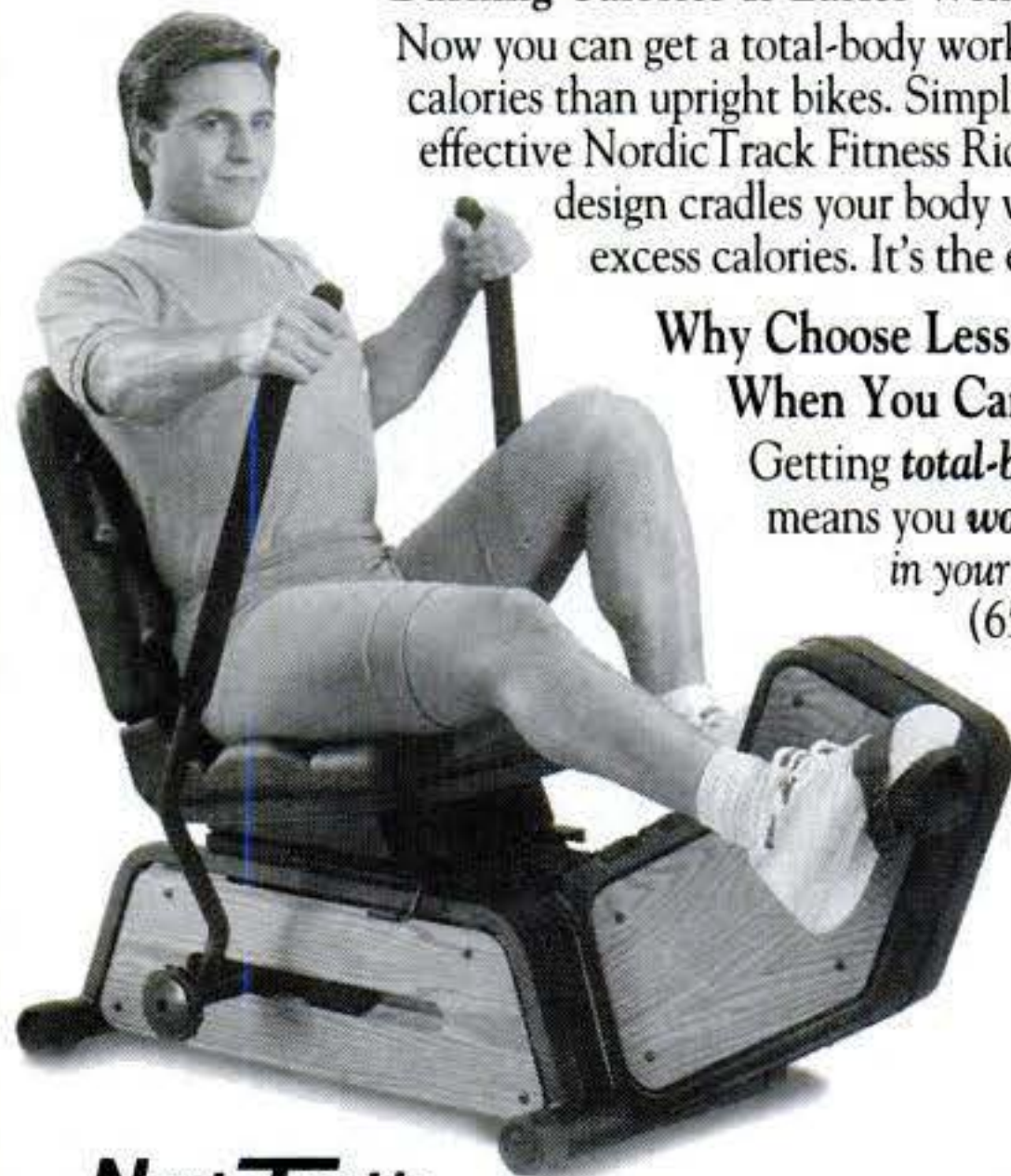
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of standardization to the machines of all manufacturers, all over the world, we would have a major breakthrough in usability."

While Hertzfeld and the others wrote code, Steve Jobs was making his mark on the Mac. Working for Jobs was a decidedly mixed blessing. On one hand, Jobs was a passionate leader, a motivating force without parallel. He insisted that the Macintosh was going to shock the world; it would not merely be great but "insanely great." It was clear that Jobs believed this. But every subordinate also saw Jobs' downside. He wore his personal demons on his sleeve and was sloppy in dealing with his workers. Jobs' criticisms took the form of acidic humiliation, even when Jobs was unqualified to judge the quality of the work in question.

Jobs was particularly finicky about the aesthetics of the Macintosh. He ordered Burrell Smith to redesign the main circuit board because it didn't look pretty enough. (No matter that no one but repair technicians would ever see the board.) Jobs also was instrumental in assuring that the shape of the machine was uniquely wonderful. "If [the Mac] would get into the Museum of Modern Art design collection, Steve would be very happy," said Jerry Manock, who produced the molding for the Macintosh case.

Jobs reminded the Mac team that they were not merely designing a computer, they were revolutionaries on a mission. He made his team feel that the quality of the Macintosh was a life-and-death issue. At one point in the software development process, Jobs was worried about the machine's distressingly lengthy start-up time—almost 30 seconds. He zeroed in on system software programmer Larry Kenyon, who believed he had already squeezed as much speed as possible from the Mac: "Even if it took you three days to make it a single second faster, it would be worth it," Jobs hounded him. "If ten million people use the computer, in one year alone, that's about 360 million turn-ons. How many lifetimes does 360 million seconds equal? Fifty? Would you take three days to save fifty people's lives?" Kenyon wound up shaving not one but three seconds off the start-up time, sparing extra souls from the Reaper.

Given the fact that Jobs was not an accomplished engineer, not an ergonomist, and not a trained visual designer, he was nonetheless correct on a startling number of issues. Atkinson once recalled when he was debating which "primitives" to include among

the standard shapes that Quickdraw could generate. He knew he would include an ellipse, a rectangle, and a circle, but decided against including a "round-rect," a shape similar to a rectangle but with rounded corners instead of squared ones. Jobs vociferously disagreed with him. To convince Atkinson, he dragged him out of the building and walked him around the parking lot, identifying a surprising number of rounded-corner rectangles—the curbs, the No Parking signs. Eventually

Atkinson came to understand that the shape was vastly underrated. He made the round-rect a Quickdraw primitive, and never regretted it. You can see this round-rect now on every dialog box and button on the Mac.

In early 1983, Jobs authorized an unusual addition to the team: Susan Kare, a visual designer whose responsibility was the "look" of the Macintosh. It was her job to imbue the Macintosh screen with uniformly attractive and functional images. Kare



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Insanely great

[Continued from page 81]

had a particular talent for creating icons. Kare's equivalent of a canvas was a little block of 32 by 32 pixels—around a thousand dots that would be blacked or left blank. Of course, as dictator of design, Jobs approved every icon. At one point, he rejected Kare's little picture of a rabbit, complaining that it looked "too gay."

Besides the icons, Kare worked on the look of the Macintosh programs. She set about refining the look of the title bar, the border on top of a window, giving it distinctive pinstripes. This was far more than a cosmetic make-over. It was partly a careful accumulation of nit-picky details—frills, pinstripes, curlicues, and the gray tint in the scroll bars—which established what has been called the "look and feel" of the Macintosh. Compared to DOS—an intimidating jumble of letters and commands—the world you enter in the Macintosh is a clean, well-lit room, populated by wry objects, yet none so jarring that it threatens your comforting sense of place. The Macintosh welcomes your work.

And if questions arise between you and the computer, lines of communication are flung open wide by a standard-looking "dialog box" that takes you by the hand to the next step. You use the mouse to slide the cursor over the proper "button." If your choice is the one deemed by the designer as the most obvious, it is double-bordered, and you know that by hitting the return key, that choice is made. These dialog boxes appear in every Macintosh program, guiding you along.

All religions have their look and feel; one glance at a cathedral and you are swept into the gestalt of the Catholic religion. Likewise, a peek at a window framed by a title bar and scroll bars is enough to evoke the sacraments of the Mac. And the Mac can even deliver appropriate messages via synthesized speech.

At the annual stockholders meeting on January 24, 1984, the 2,571 seats of an auditorium near Apple's headquarters are filled. At ten o'clock, Steve Jobs appears.

Jobs recites a version of Bob Dylan's "The Times They Are A-Changin'." Then he gives a brief lesson in computer history, concluding with the looming threat of IBM. Finally, loudspeakers boom the strains of "Chariots of Fire." And out of a canvas bag, Jobs lifts the computer that means the future of his company and portends something for all our futures.

"Hello," the computer says. "I am Macintosh. It sure is great to get out of that bag."

PS

The new American home

[Continued from page 77]

Calif., these SmartBlocks remain in place after the concrete sets, giving the walls an insulation value of R-17.6.

The exterior stucco is also not what it seems. Acrylic-based Dryvit Sprint compound was applied to the Smart-Block foam surfaces; when mixed with cement, this material makes even concrete stucco flexible to resist weathering and cracking in the tough desert climate. The richly variegated "stone" walks and patios were created from concrete—which was stained, patterned, polished, and sandblasted to create convincing trompe l'oeil effects.

Although it's invisible inside the finished home, another departure from typical residential construction practices is the light-gauge steel used in the interior wall and roof framing. Steel is common in commercial structures but is just beginning to gain acceptance among home builders. One reason for this is the recent dramatic rise in wood prices, spurred by the continuing furor over the trade-offs between harvesting lumber versus maintaining more mature, old-growth forests.

Other innovations in the home include polybutylene plumbing lines and pressurized water-system manifolds. Like a home's electrical panel, the manifolds serve as accessible "switchboards" for the domestic water supply and distribution. Shutoff valves are provided at the manifolds for each of the hot and cold water "branch circuits."

In the circular glass-block-walled master bath, double MasterShower Towers from Kohler feature electronic keypads that control each unit's multiple outlets; both units include two body sprays and three-way shower heads. And in the children's area, a Jacuzzi J-90 steam and shower cabinet helps to save space.

Practicality and aesthetics also combine in the high-efficiency Heatilator gas fireplace in the living room. Nevada enforces one of the nation's toughest fireplace emissions codes, but this unit burns so cleanly that it requires no chimney; instead, it can exhaust directly through the wall behind it. For evenings outdoors, another of the home's four gas fireplaces is located in the central courtyard.

All of the products in The 1994 New American Home are available now or will be in production before the end of this year. The home was designed by architects McLarand, Vasquez & Partners of Santa Ana, Calif., and built by Heartland Homes of Las Vegas. Price: The house will be sold at \$1,900,000. **ES**

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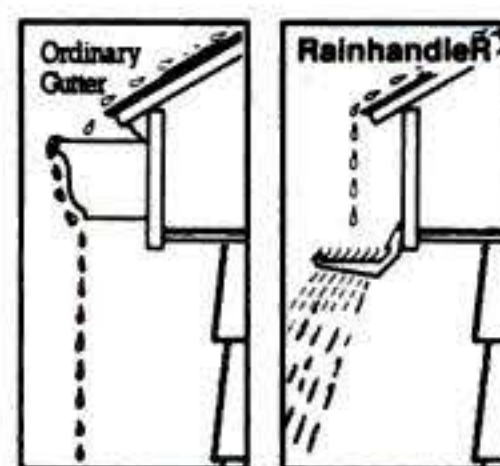
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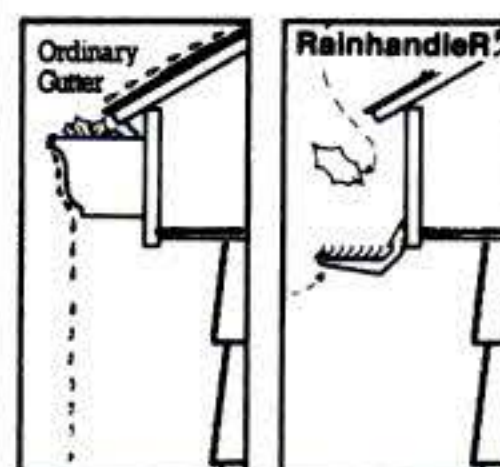
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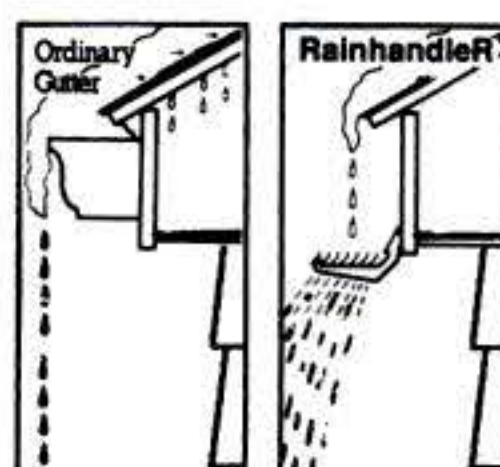
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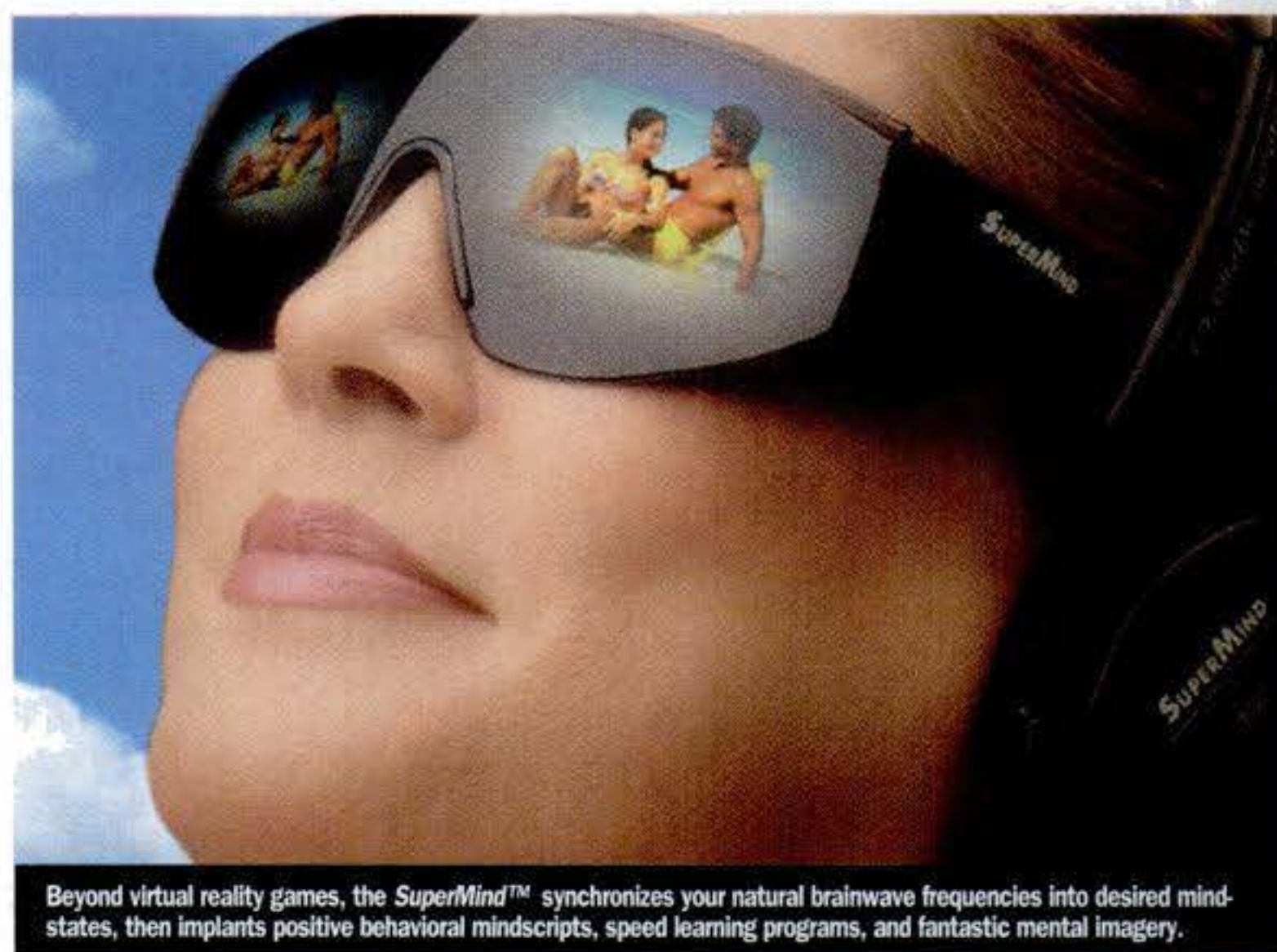
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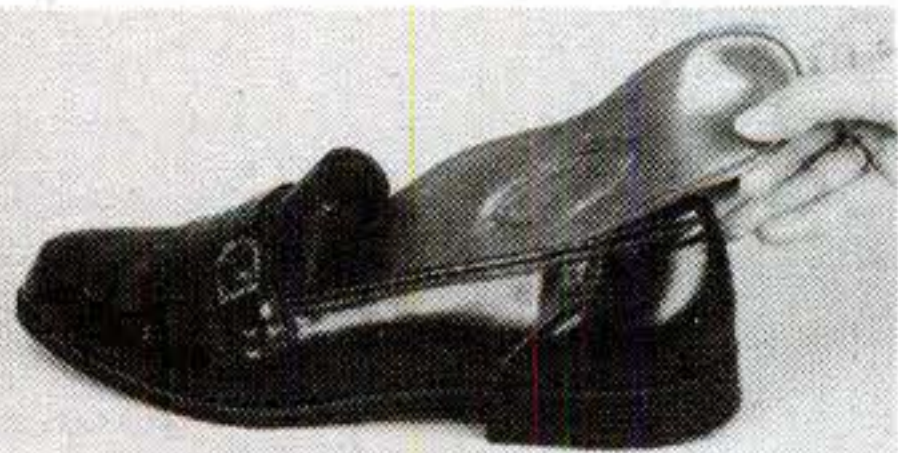
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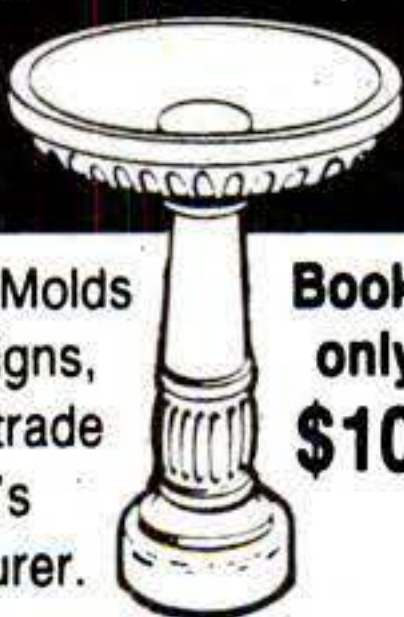


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| YES | NO |
| ☐ | ☐ |
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- | | |
|--------------------------|--------------------------|
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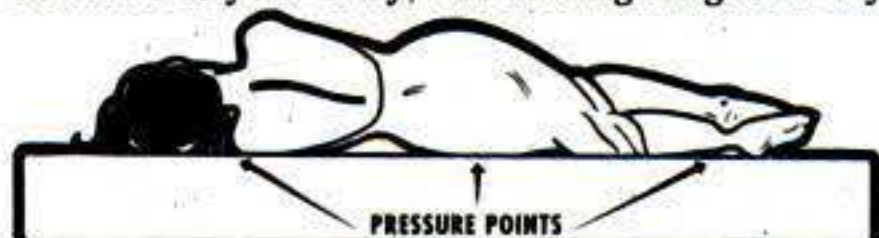
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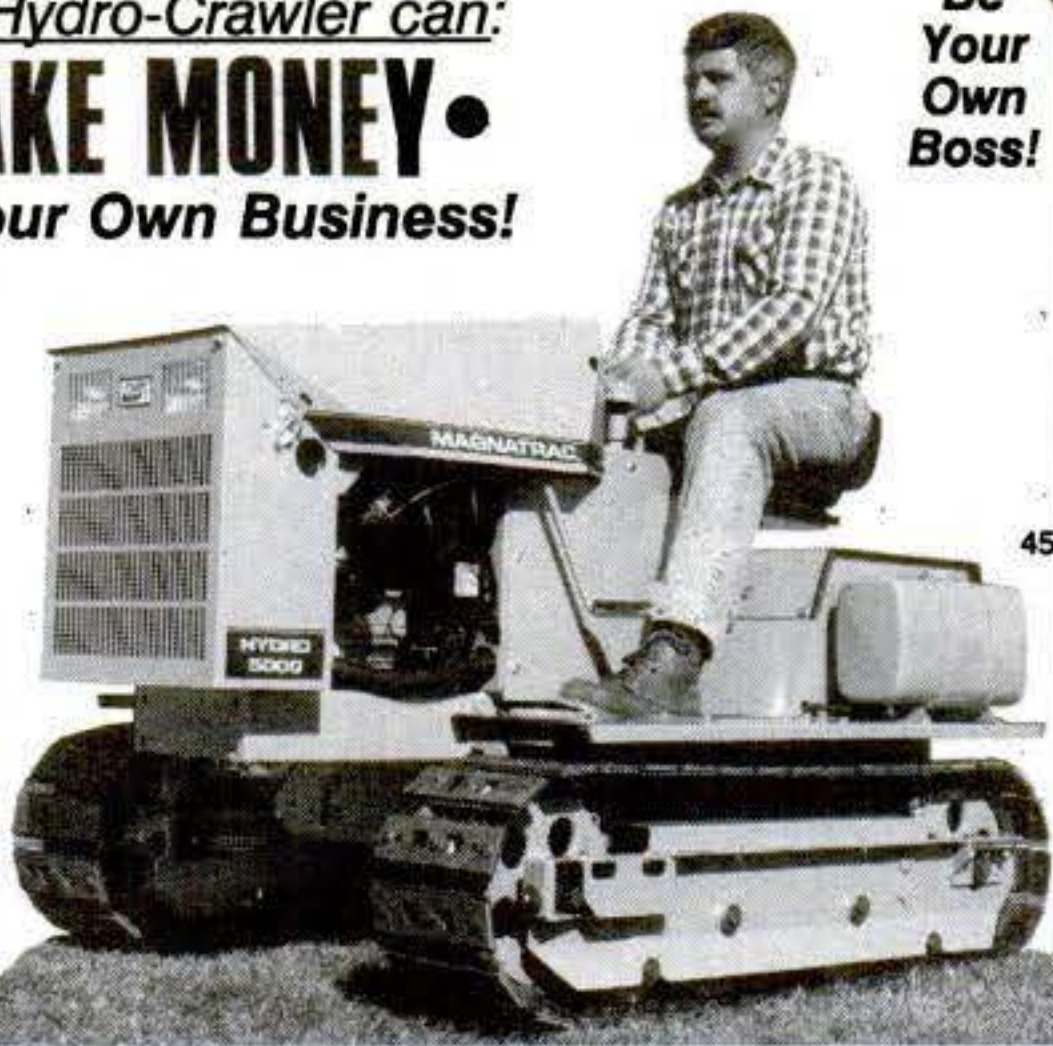
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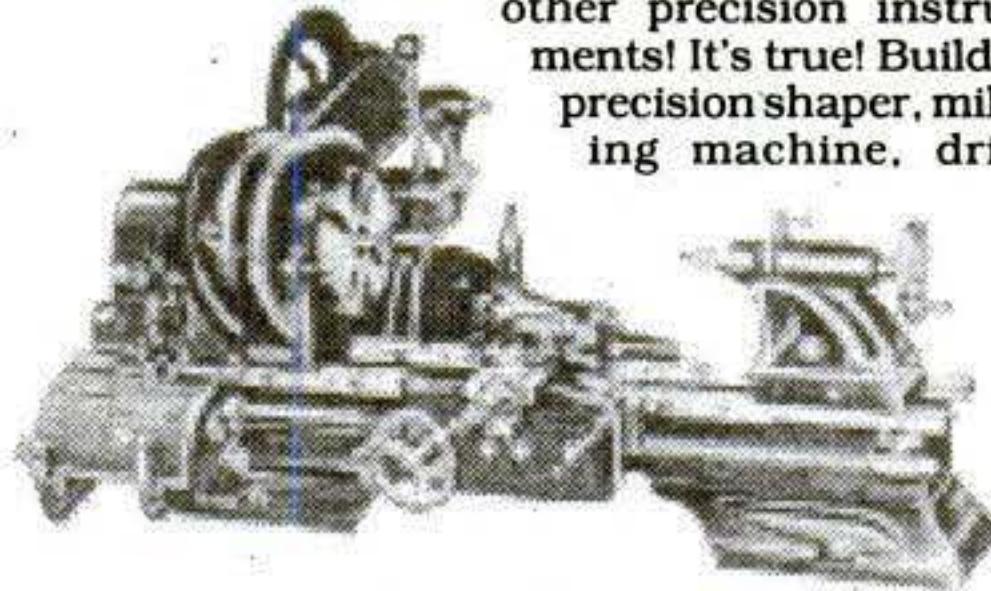


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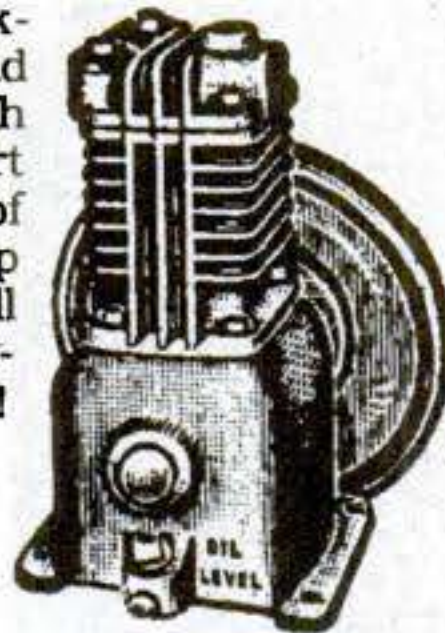


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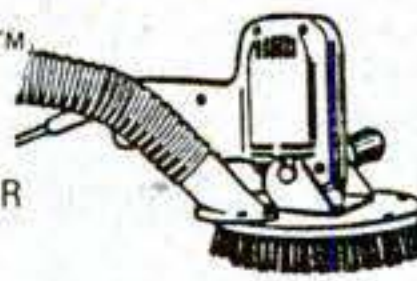


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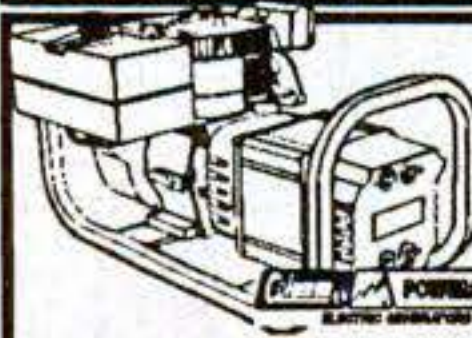
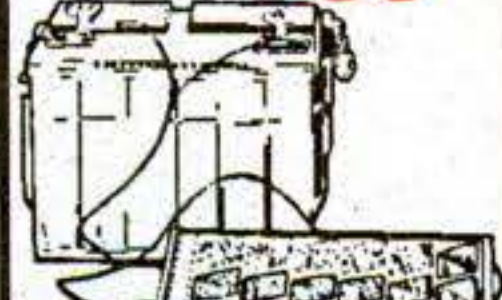
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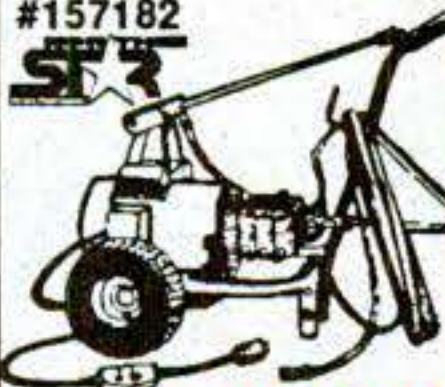
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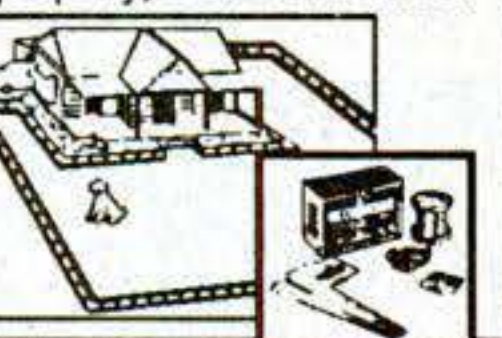


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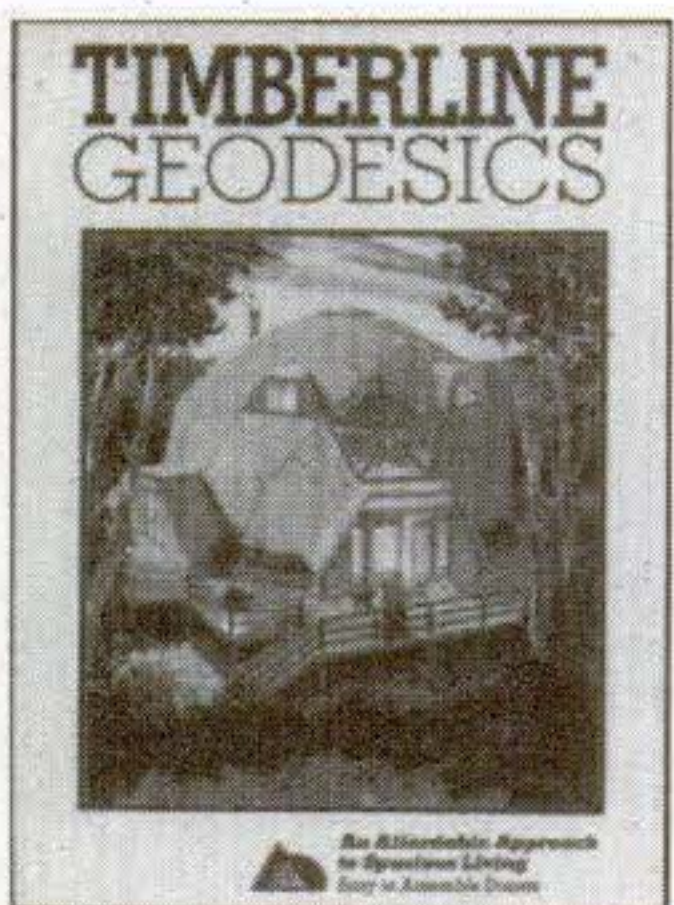


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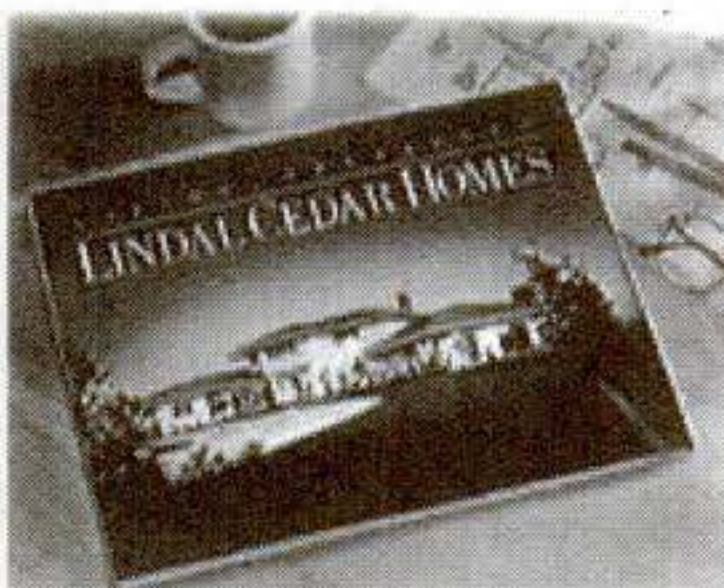


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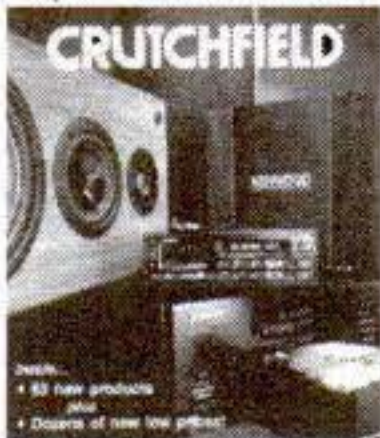
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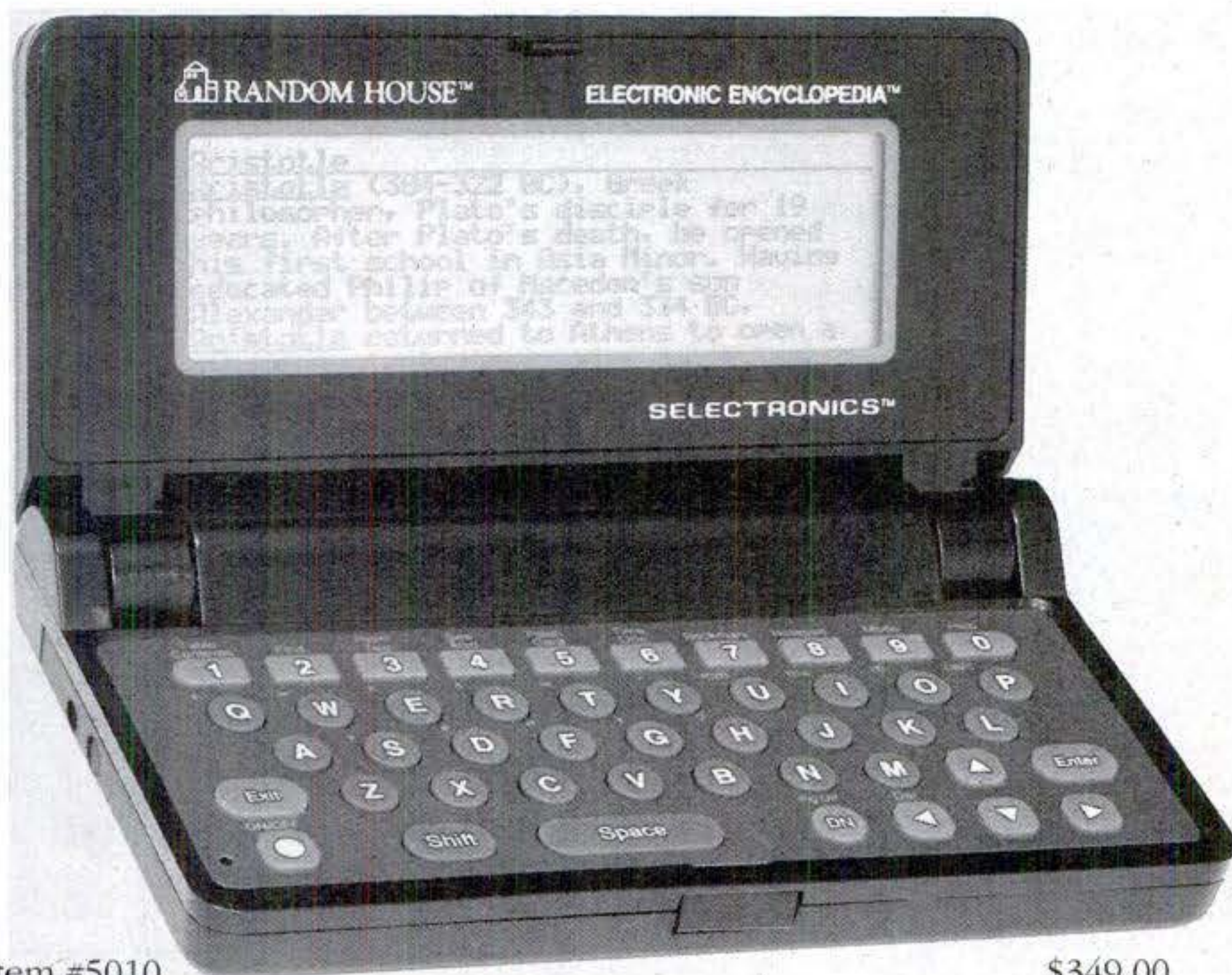
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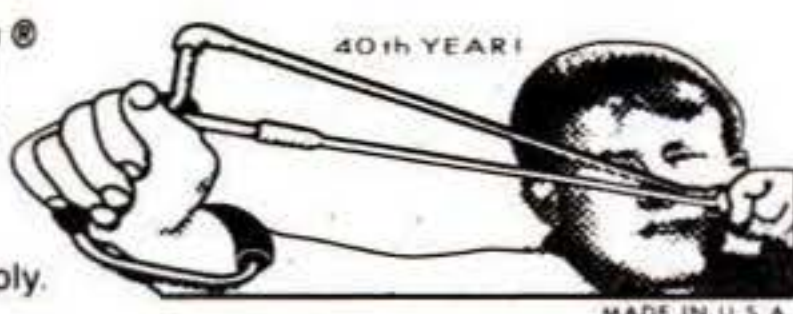
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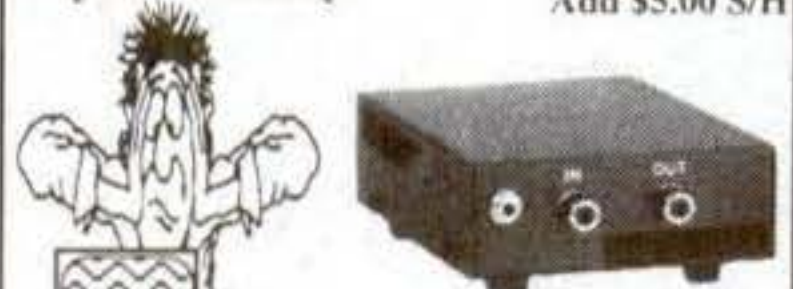
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100 YEARS AGO

PLANT LIFE BENEATH THE SEA

Based on the premise that plant life depends on sunlight, it was believed that at ocean depths of more than a few hundred fathoms, "no organisms, excepting a few parasitic fungi were to be found."—February 1894

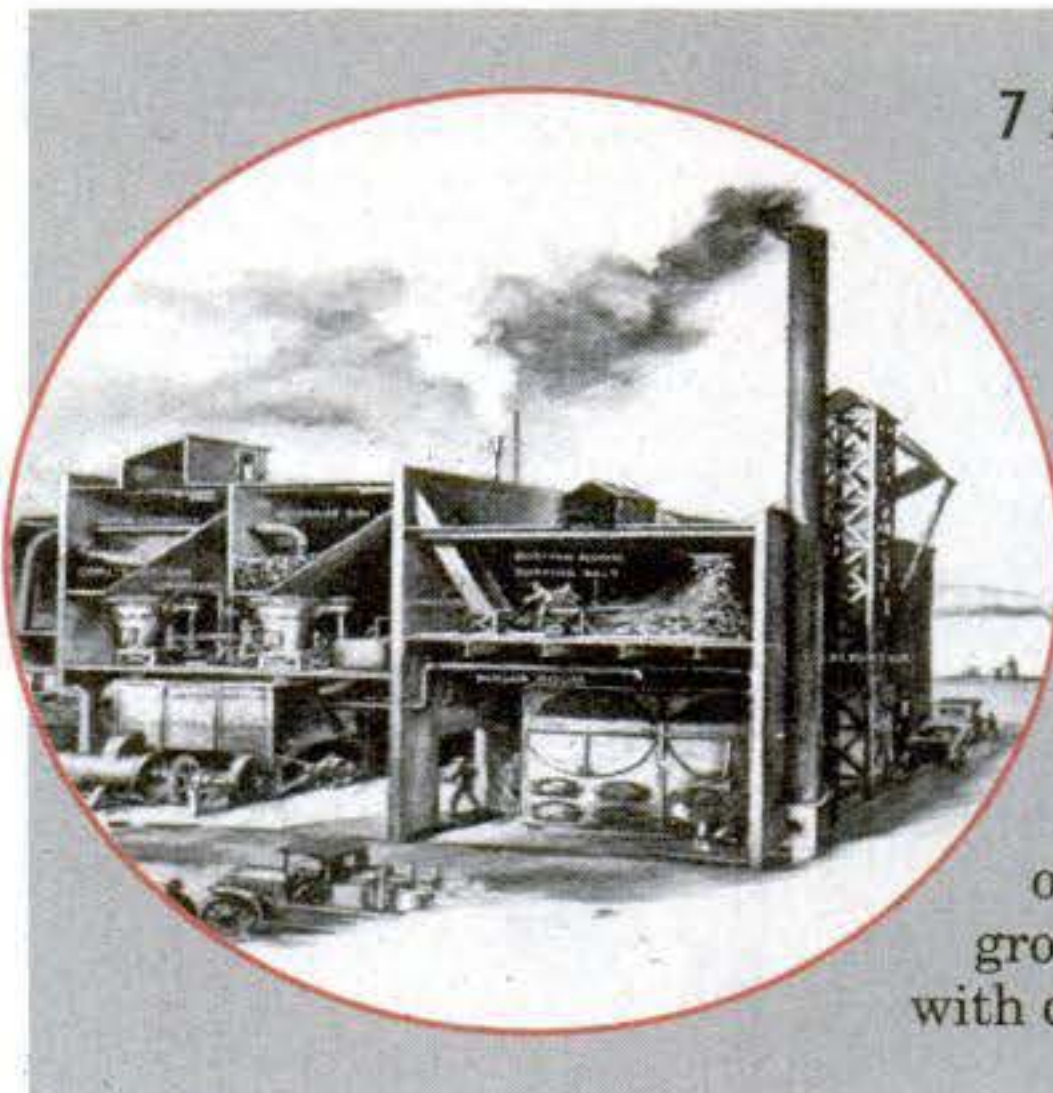
In 1977, vast communities of plant and animal life were discovered surrounding volcanic vents more than 10,000 feet below the ocean's surface. These organisms require no sunlight to survive.

25 YEARS AGO

THE BIRTH OF COMPOSITES

The advent of the space age stimulated the search for stronger, stiffer, yet lighter materials. The great success of fiberglass led to further research into fiber-reinforced composite materials, wrote Dr. Wernher von Braun. Composites were first tested on airplanes as rudders, landing gear doors, and horizontal stabilizers.—February 1969

Graphite composites are currently used in products ranging from rockets to sports equipment.



75 YEARS AGO

FUEL FROM GARBAGE

A Chicago inventor devised a plan to use trash for heating. Heaps of garbage were sanitized with creosote, sorted, ground, and mixed with coal dust.

Adding water and tar produced a pulp that could be made into bricks. The two-pound bricks, equivalent to bituminous coal in energy content, were dubbed oakoal because they burned like oak and left the same white ash.—February 1919

Although demonstration recycling plants are now in operation, garbage has yet to become a viable alternative fuel.

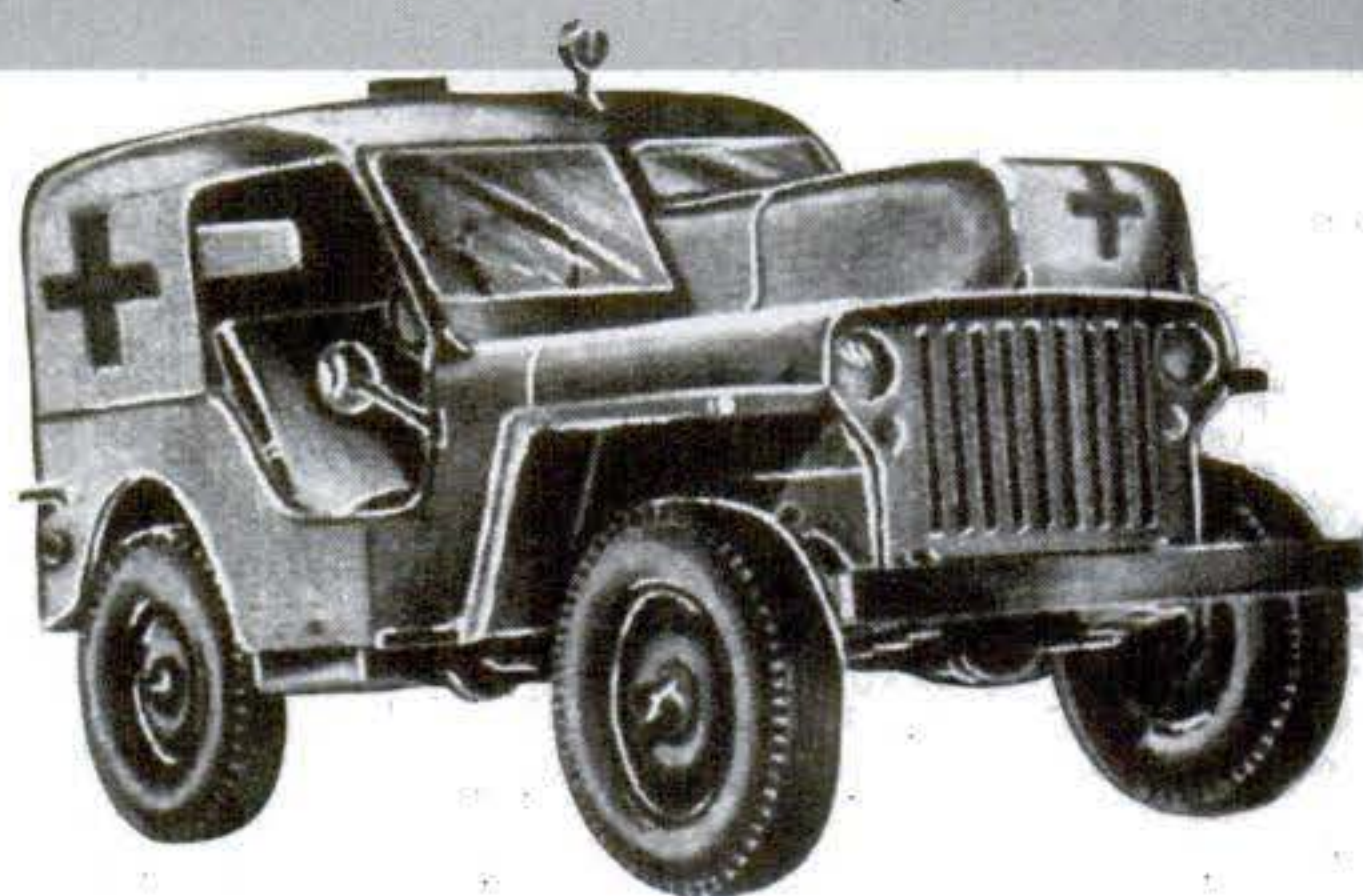
25 YEARS AGO

JUST LIKE A WOMAN

I found them a bit like women, seductive and unpredictable," wrote Jacques Cousteau of his tiny, one-person submarines. The size and maneuverability of what



Cousteau's researchers referred to as "sea fleas" were unsurpassed. The pilot lay prone in the three-foot by six-and-a-half-foot, battery-powered hull. A single control stick allowed the diver to be both pilot and observer. Two color-movie cameras and jet-propulsion units capable of 360-degree rotation allowed the pilot to record anything of interest. These mechanical marvels gave Cousteau the opportunity to convey to the world his love of the ocean.—February 1969



50 YEARS AGO

NEW ROLES FOR THE JEEP

More than a third of the entries in a contest sponsored by POPULAR SCIENCE, "1001 Postwar Uses for the Jeep," recommended uses on the farm. While many proposed outfitting the jeep as everything from a sports car to a police cruiser to an ambulance, servicemen were adamant that "our little wonder warrior" stay its own homely self. One reader was appalled that a vehicle meant to do a "man's job" in rough country might be used "to take 'old women' to tea parties."—February 1944

Today, the macho jeep is at home both on the road and off, from fashionable Rodeo Drive to jeep trails in the Rockies.

75 YEARS AGO

WHAT WILL THE BREWERIES DO?

When this article is read, every brewer in the United States will have shut up shop." Prohibition forced breweries to produce something other than alcohol. Despite repeated warnings, few breweries had made alternate plans when the law took effect. Conversion options were limited due to specialized equipment and building structures.—February 1919



Many breweries produced malt syrup, malt flour, and malted milk until Prohibition was repealed in 1933.



Know how it feels to find what you've been looking for.

How would it feel to be an Army Cavalry Scout, maneuvering across terrain to gather intelligence? To be a master of field craft, map and navigational skills? To attune your senses; your vision, hearing, even your sense of smell as never before? To move boldly on your own judgment, track your objective and relay the critical information back to your command?

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The fly-fisherman thoughtfully working the remote mountain stream no more resembles the typical weekend angler than the Toyota T100 resembles the typical pickup truck. For unlike any other truck, the Toyota T100 in its introductory year was ranked, *based on T100 owner surveys*, The Best 'Full-Size' Pickup In Initial Quality.[†]

Do not be misled by the ease at which Toyota accumulates such awards. The new qualities that surface in a vehicle such as the 1994 Toyota T100, standard driver-side



*T100's New Standard Driver-Side Air Bag.**

air bag* and side-door impact beams, can be directly linked to Toyota's commitment to remaining a leader at providing customer satisfaction. The same is true of the

Toyota T100's unique size. Big enough to provide for impressive payload/towing capabilities, yet not so big as to impair per-

formance and agility. As for the level of comfort found in the Toyota T100's quiet car-like cabin, only the word 'unexpected' seems fitting. Clearly the Toyota T100

puts you in a whole new class of truck. But you already knew that.

TOYOTA T100

"I love what you do for me."

Call 1-800-GO-TOYOTA if you'd like a Toyota T100 brochure and the location of your nearest dealer. *Always use your seatbelt. Driver-side air bag is a Supplemental Restraint System (SRS). †J.D. Power and Associates 1993 Light Truck Initial Quality Survey. Based on a total of 11,719 consumer responses indicating owner-reported problems during the first 90 days of ownership. Buckle Up! Do it for those who love you. © 1993 Toyota Motor Sales, U.S.A., Inc.

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